Telephone Engineer

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CONTENTS FOR THIS ISSUE

EDITORIALS 15-16
HARRY FARIS DIES — RATE INVESTIGATIONS COST MONEY

LOW CAPACITY FUSES IN TELEPHONE PLANT—*By B. C. Burden*.....17-18

NEBRASKA HOLDS 33RD CONVENTION.....19-40

SOME PHYSICAL CHARACTERISTICS OF SPEECH AND MUSIC—*By Dr. Harvey Fletcher*.....
.....20-21-22, 23-26-27

TELEPHONE NEWS FROM THE SOUTHWEST.... 28

VACUUM TUBE THEORY AND PRACTICE....29-30-40

TELEPHONE ACTIVITIES IN FOREIGN COUNTRIES 31

THE TECHNICAL CLEARING HOUSE—*By B. C. Burden* 32

WASHINGTON, MO., GETS COMMON BATTERY—*By P. Winemiller and J. P. Galligan*.....33-34

ADVERTISING IS THEME OF IOWA CONVENTION.35-46

ALL-RELAY AUTOMATIC EXCHANGE EQUIPMENT 36-38

RAMBLINGS 42

NEWS FROM THE FIELD..... 44

WITH THE MANUFACTURERS AND JOBBERS.... 45

Harry Faris Dies

It was with sorrow and regret that we learned of the death of Harry Nelson Faris, technical engineer for the United Telephone company, Abilene, Kans., which occurred the evening of March 3.

Mr. Faris had been ill since early in December, when he collapsed in Oklahoma City on his way to spend a vacation in Texas. He improved sufficiently to return to Abilene in January, but gradually weakened since that time.

Recognized as one of the outstanding engineers in the United States, Harry Faris frequently was called upon to solve vexing problems for all sizes and classes of telephone companies. Since April 1, 1926, he was connected with the United organization and made his headquarters in Abilene. Prior to that time he was Kansas City manager for the Kellogg Switchboard and Supply company for many years.

Mr. Faris probably knew more telephone men than anyone else connected with the industry. He was a favorite speaker at conventions and meet-

ings and the large number of persons who always attended the sessions where he was on the program attested to his popularity. On several occasions he contributed articles based on his expert technical knowledge to TELEPHONE ENGINEER.

Many telephone men in all parts of the United States will pause to remember how Harry Faris helped them get their foundation in the telephone business. He was very active in the early days when telephone service was new to the Middle West in organizing and strengthening the pioneer efforts to give service. Many men prominent in the utility industry would have given up in discouragement without his assistance.

Mr. Faris had an amazing ability to grasp all the essentials of a problem. This, coupled with a remarkable memory, gave him rapid solutions. He was a telephone genius and his passing will be deeply felt both by the United companies and the industry as a whole.

Harry N. Faris was born August 10, 1879, on a farm near Tarkio, Mo. At the age of two years he accompanied his family to Washington county, Kansas, where he was reared to manhood. He attended the rural district school and was graduated from the Washington high school in 1899. He spent two years at the University of Kansas and began his association with the telephone industry while still a student. He became associated with the Kellogg Switchboard and Supply company as a salesman in 1902 and remained with them in various capacities until shortly before joining the United companies in 1926.

He was 52 years 7 months old at the time of his death. He is survived by his widow, two sons and three daughters, Harry H. Faris of Harrisburg, Pa.; William R. Faris, Spring Hill, Kans.; Mrs. Houghton Cross, Chicago; Dorothy Faris, a student at the Oklahoma State College, Chickasha, Okla.; and Betty Faris of the home; two brothers, William R. Faris, Spring Hill, Kans., and Edwin E. Faris, Las Animas, Colo.; and thousands of friends among the telephone people of the Middle West.

Rate Investigations Cost Money

TELEPHONE ENGINEER is fully sensible of the difficult conditions under which operating telephone companies are carrying on in many parts of the country. An examination of the facts, however, leads to the suggestion that possibly operating conditions are not as unsatisfactory as it is popular to consider them at this time.

Two or three facts are being clearly developed and these two or three facts are sufficiently important and basic to command the careful attention of everyone connected with our industry. The first fact, which is very apparent, is that present conditions afford a fertile soil for the spreading of political propaganda designed to appeal to the ancient antagonism against public utilities. This propaganda has been successfully met by a number of telephone companies through patient, courteous, educational work. Endless investigations of public utilities' rates, interminable hearings before regulatory commissions, detailed appraisals of plant, all cost a great deal of money, and the expense of all such activities must inevitably be passed back to the telephone subscriber in his rates for service. When this fact is patiently and clearly explained to complaining subscribers, it will be effective.

Of course, there are people who could afford a telephone last year who cannot afford a telephone this year. Their inability to pay for telephone service is just as honest and substantial as their inability to pay for other necessities which have been eliminated from the family budget. When a subscriber is actually unable to pay for telephone service, and it is the opinion of TELEPHONE ENGINEER that the total number of subscribers falling within this classification is negligible, then the service should be discontinued and should remain discontinued until such time as conditions change.

Every telephone which is ordered out should be treated as a separate individual transaction by the telephone company and the subscriber should be courteously interviewed in order that the real reason for discontinuing the service may be developed. With a proper foundation and courteous, painstaking work on the part of the interviewers, a large operating company recently placed in effect a very substantial increase in local rates with a negligible loss in subscribers, although the community involved was one in which the so-called "industrial depression" was very acute.

Instead of bewailing the fact that people are ordering out their telephones, TELEPHONE ENGINEER believes that the present is a most promising period in which to improve the service rendered to the utmost; eliminate all unnecessary items of expense (and this should be done in good times as well as bad); increase rates where the rates are lower than they should be to permit the rendering of first-class service at a reasonable return for the property; exert every effort to patiently and thoroughly meet destructive political propaganda; and carry on in the sincere belief that our great industry is furnishing a commodity worth a great deal more than it costs to the average subscriber, which is not a luxury but is a necessity, and which in the case of almost every individual is a means by which great economies may be effected.

Low Capacity Fuses in Telephone Plant

Characteristics of "Littelfuses" Used to Protect Instruments from Burnouts Due to Electrical Testing Instruments with Low Range Meters Here Explained by B. C. Burden, Transmission Engineer, Lincoln Telephone and Telegraph Company, Lincoln, Nebraska

General

Electrical testing instruments such as are used in the telephone field for measurement of the extremely small voice frequency currents, or the direct current required for relay operation are very easily damaged, if overloaded.

Due to the high cost of testing instruments it has always been necessary to exercise considerable care in making measurements with low range meters, and even then instrument burnouts have been all too frequent.

Until the last few years no positive means have been available for protecting instruments against burnouts. However,

Fig. 1—Construction of Littelfuse

at the present time there is available a recently designed low capacity fuse which is almost 100 per cent effective in preventing instrument damage from overloads. It is the purpose of this article to discuss briefly the various characteristics of these fuses which are known by the trade name of "Littelfuses."

History of Littelfuse

Littelfuses are the result of the efforts of E. V. Sundt in collaboration with Bernard Kollath (formerly a model maker with the late Dr. Steinmetz). Experiments were conducted for many months by these men in an effort to design a reliable method for protecting sensitive electrical instruments.

Magnetic circuit breakers, electrolytic valve action, and many types of fuses were tried out to determine the most suitable means for providing positive protection against instrument "burnouts."

After much experimentation it was found that nothing of a reasonable cost acted as quickly as an extremely small diameter alloy wire.

The minute size of the fuse wire required for protecting meters drawing only one milliampere or less made it necessary to design a new type of fuse shell and special methods for assembling the small fuse in shell.

All of the problems incident to the design of the "low capacity" fuse were successfully overcome and in 1928 a company was organized to manufacture and sell a line of protective fuses which were given the name "Littelfuse" as descriptive of their use in the electrical industry.

Since the initial introduction of Littelfuses in 1928 the demand for these fuses has grown until at the present time Littelfuses are relied on for the protection of hundreds of thousands of dollars' worth of testing instruments in the power, telephone, and radio industries.

CONVENTION SCHEDULE

Texas Independent Telephone Association, Texas Hotel, Fort Worth, March 22, 23, and 24.

South Dakota Telephone Association, Hotel Cataract, Sioux Falls, April 6-7.

Ohio Independent Telephone Association, Deshler-Wallick Hotel, Columbus, April 12-13.

Kansas Telephone Association, Jayhawk Hotel, Topeka, April 19-20.

Wisconsin State Telephone Association, Loraine Hotel, Madison, April 26, 27, and 28.

United States Independent Telephone Association, Southern District, Bristol, Tenn., May 4, 5, and 6.

Indiana Telephone Association, Claypool Hotel, Indianapolis, May 11 and 12.

Pennsylvania State Telephone & Traffic Association, Penn-Harris Hotel, Harrisburg, May 17, 18, and 19.

Up-State Telephone Association of New York, Jamestown Hotel, Jamestown, May 25, 26, and 27.

Constructional Features of Littelfuses.

Littelfuses of the low voltage type, such as are used for the protection of testing instruments, are 1 in. by 0.25 in. in size. Figure 1 illustrates how the extremely small fuse wire is connected to

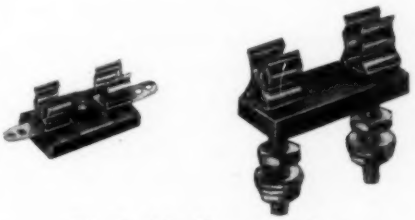


Fig. 2—Littelfuse mountings

the terminal end caps. It will be noted that the ends of the small glass tube are constricted so that the special solder, which is used to connect the fuse wire to the cap, surrounds this constricted part of the tube in such a manner that the caps are locked in place and the tube hermetically sealed. Tests show that the caps are held so firmly in place that they cannot be loosened even by rough handling. This is quite important as a loose cap might easily break the delicate filament.

A number of mountings are available and those of particular usefulness in the telephone field are shown in figure 2.

For experimental work and for use with instruments where it is not convenient to mount the fuse inside of the case a special Gryp-Connector is available which is so arranged that the fuse is held in a special holder provided with convenient terminals. This type of connector is particularly useful for temporary hook-ups, etc.

Electrical Characteristics of Littelfuses

Littelfuses are available in capacities of 1/100, 1/32, 1/16, ⅛, ¼, ⅜, ½, 1,

A *B*

Fig. 3—Oscillograph records of short circuit effects. (a) Time required to find 1 milliampere meter 0.173 seconds. (b) Time required to find 1/32 ampere Littelfuse.

and 2 amperes. (Note—other higher capacity and higher voltage rating fuses are available but will not be discussed here.)

The following table gives the application, maximum load in milliamperes, temperature coefficient (in terms of ohms per milliampere load current), fusing point, and average resistance of each type of fuse under a 5 milliampere load.

Theory of the Littelfuse

It will be noted from this table that either a 1/100, or 1/32 ampere fuse is recommended to protect a 1 milliampere meter against burnouts.

At first thought it seems unreasonable to utilize a fuse that will carry over 30 milliamperes to protect a one milliampere meter, as this constitutes over a 3,000 per cent overload.

However, it is true that a (1/32 amp.) Littelfuse will provide positive protection to a one milliampere meter.

The protective action of such a fuse is based on the fact that electrical testing instruments are not burned out by slight overloads of several times the scale reading but rather by exceptionally high

Table No. 1—Littelfuse Electrical Characteristics

Rating Amps.	Instrument Application	Max. Load in m. a.	Tem. Coef. Ohms per m. a.	Fuse Point	Aver. Resistance
1/100	Wheatstone Bridge Galvanometers, microammeters, 0-1 m. a. meters, 0-5 m. a. thermo-couple meters. Sensitive relay ccts.	5	1.10	20	138.
1/32	0-1 m. a., 0-5 m. a. meters, 0-5, 0-15 thermo-couple meters. Sensitive relay ccts.	15	1.40	40	65.
1/16	0-5, 0-10 m. a. meters, 0-15, 0-50 m. a. thermo-couple meters.	65	.0114	85	21.
1/8	0-10, 0-50 m. a. meters, 0-100 m. a. thermo-couple meters. B battery circuits in radios and sound amplifiers (where current does not exceed 100 m. a.)	100	.0100	155	16.
1/4	0-50, 0-100 m. a. meters, 0-100, 0-150 thermo-couple meters. Radio and sound amplifiers.	200	*	260	6.2
3/8	0-100, 0-200 m. a. meters, 0-150, 0-250 m. a. thermo-couple meters. Sound amplifiers	300	*	380	3.0
1/2	0-200, 0-300 m. a. meters, 0-250, 0-350 m. a. thermo-couple meters. Small rectifiers. Battery supply circuits.	400	*	520	2.5
3/4	0-300, 0-500 m. a. meters, 0-1 amp. thermo-couple meters. Rectifiers. Battery supply circuits.	600	*	800	1.0
1	0-500, 0-750 m. a. meters, 0-1 amp. thermo-couple meters. Rectifiers. Battery supply circuits.	1000	.00014	1400	.36
2	0-750, 0-1500 m. a. meters, 0-1, 0-2 amp. thermo-couple meters. Rectifiers. Battery supply circuits.	2000	.00002	2750	.14

*Negligible.

overloads of several thousand per cent.

The coils of D'Arsonval type instruments are wound with fine copper wire which has a fairly high current capacity (in m.a.) therefore an overload of several hundred per cent of full scale current merely throws the instrument needle off scale without in any way damaging the winding.

It is therefore obvious that if a low capacity fuse which will quickly blow under severe overload conditions, is inserted in series with the meter, that the fuse will open the circuit before the moving coil of the meter has a chance to be damaged. In other words the fuse lives up to its slogan "quicker than a short circuit."

Oscillograph Records of Littelfuse Action

To illustrate this action and to get some visible information on it, a number of Littlefuses, meters, and vacuum tubes were "blown" by being connected directly across a 110 volt d.c. generator. An oscillograph record was made in each case and some of these are shown in figure 3. The tests which were made in the physics laboratory of Northwestern University, show exactly what happens when a meter burns out or a Littelfuse blows.

The oscillographs were taken on a two element machine. One element was connected to a 1,000 cycle per second oscillator and its beam of light traces a continuous wave on the photographic film. This is used as a timing wave. The lower line is a fixed base line. The upper line shows the current conditions in the circuit to which the second element is connected. It is produced by a beam of light from the mirror attached to the coil to which the apparatus under test is connected. In (a) of figure 3 is shown the record taken when a 1 milliampere meter was connected across a 110 volt circuit. It will be noted that the meter burned out in .173 seconds after the current was turned on. In illustration (B) of figure 3 the record of a 1/32 ampere fuse connected across a 110 volt circuit is shown. It will be noted that in this case the fuse opened in slightly less than .001 second. From this it is obvious that the fuse would open the circuit long before the moving coil of the meter could possibly be damaged.

By following the recommendations given in the table above instruments can be adequately protected against severe overloads.

Applications of Littelfuse in the Telephone Field

The principal uses of Littelfuses in the telephone field is in connection with the protection of d.c. milliameters. Because of the low resistance of D'Arsonval type milliameters they are very easily burned out by comparatively low voltages impressed directly across their terminals.

The new rectifier type meters which are becoming quite popular in the telephone field for transmission measurements should by all means be protected as the calibration of such meters is easily ruined by excessive current flow, even though the moving coil winding is not damaged.

In connection with experimental work Littelfuses are cheap insurance, and test leads should be arranged with a Littelfuse mounting permanently connected in a series with one of the leads, thus permitting the fuse to be readily changed as desired.

Sensitive relays which operate on exceptionally low current values, and which are used in connection with photoelectric cell application should be protected with low capacity fuses.

FIRST LONG DISTANCE DIRECTORS' MEETING SUCCESS

What is said to be the first board of directors' meeting ever held over long distance telephone line, was conducted recently by directors of the Rochester (N. Y.) Telephone corporation.

Ten members of the board, meeting in the corporation's offices in Rochester, each provided with a Stromberg-Carlson telephone and head receiver, heard the sound of the falling gavel of their chairman, Fred C. Goodwin, who called the meeting to order at his hotel, The Huntington, in Pasadena, California.

The entire transaction took eleven minutes, and John P. Boylan, president of the corporation, said it was the first time that such a meeting had been conducted. He added that it demonstrated the versatility of telephone service.

There were only two connections made on this circuit between Rochester and Pasadena. These two were at Chicago and Los Angeles. The Rochester operator rang Chicago direct, Chicago rang Los Angeles and Los Angeles called Pasadena. The lines west of Chicago were via Omaha, Denver, Salt Lake City, across the Rocky and Sierra Nevada Mountains to Los Angeles.

The roll-call was made by William J. O'Hea, secretary of the Rochester corporation. Attending the meeting, besides Mr. Boylan, were William B. Woodbury, New York vice-president; Frank J. Brookman, vice-president; T. Carl Nixon, J. Foster Warner, Raymond N. Ball and W. Roy McCanne, Rochester directors; James W. Hubbell, Albany, and Heber E. Wheeler, Canandaigua, N. Y., directors.

Eleven minutes after the meeting began, all matters scheduled for the meeting had been covered and Rochester again had the distinction, Mr. Boylan asserted, of "originating a plan whereby it is possible for a group of men located in different parts of the country, representing industrial, state and national affairs, to meet together for discussion of an action on their respective problems."

Nebraska Holds Thirty-Third Convention

Delegates Discuss Complex Modern Problems; Re-elect George E. Becker, President; Pass Resolution Opposing Tax on Long Distance Messages; Advocate Construction, Extensions and Replacements When Possible; Urge Systematic Advertising and Publicity Programs

Problems today facing all small telephone companies were thoroughly discussed at the thirty-third annual convention of the Nebraska Telephone Association held in Omaha, February 9, 10 and 11. The chief interest of the convention delegates was centered on advertising and publicity for the industry, methods of meeting the rural situation, the proposed tax on toll messages, and whether it is sound business policy to take advantage of low construction costs to make extensions and replacements along with added maintenance.

Speakers agreed that all managers should carry to their patrons oftener, and with greater stress than ever before, the problems of rates and service, and suggested that this be done by systematic advertising and personal contacts through organizations, and individual contacts with patrons.

In regard to spending money for added maintenance, the advice was to look the field over, having in mind the fact that the small towns seem doomed so far as growth is concerned, and that where work is needed, to do it.

Oppose Toll Taxes

The convention unanimously passed the following resolution and directed that a copy of it be sent to all Nebraska senators and representatives at Washington.

"Be it Resolved, That the Nebraska Telephone Association hereby expresses its opposition to the imposition of taxes on telephone toll messages, calling attention to the fact that the proposed taxes, expressed in percentages, are terrifically high sales taxes, particularly on the short-haul business. The telephone companies of Nebraska would serve approximately 250,000 stations in Nebraska."

In his annual address, President George E. Becker of Pawnee City said he felt the mistakes of members of the Nebraska association during the past year had been more of inaction rather than action.

He said, however, that good results had come from efforts of the directing board during the year to secure better cooperation between the companies. He said Secretary George M. Kloidy had succeeded in stimulating company advertising, with the aid of the Northwestern Bell Telephone company and the Lincoln Telephone & Telegraph company, and that the newspapers had been friendly and willing to give space to news items about the industry and its operations.

Urge Rehabilitation Program

President Becker gave strong backing to the theory that this is a good time, with labor costs lessened and the prices of materials and supplies lower to do whatever rehabilitation work can be done. He advised that company managers do this whenever funds and labor are available, to reduce maintenance costs.

He said that in Nebraska, as in other states, farmers had been found more than willing to work out past due rentals and then ask for more. In this way, he brought out, the labor of such rehabilitation work can be had, with the only cost that of transporting part of these crews to working points.

W. E. Bell, association treasurer, reported receipts during the year of $6,304, and expenditures of $6,087, closing the year with an accumulated balance of $1,552.

Secretary's Report

Secretary Kloidy reported a total of 92 member companies in the association, a net gain of two over last year, with the number of stations represented as 220,648, a new gain for the year of 648.

Mr. Kloidy said the only measure asked from the legislative session by the industry was a law providing procedure for the acquisition of a right-of-way by telegraph and telephone companies on highways whenever necessary, regardless of the load carried, and the location. The bill was passed, and is now a law, he said. He also reported that no adverse legislation was passed.

M. T. Caster, the association's representative on the joint committee on physical relations between electrical supply and signal lines, reported that the committee had held in November its 43rd meeting since its organization a dozen years ago, and that less trouble was being found in ironing out difficulties caused by new construction in occupied territory.

H. H. Carl, foreign wire relations engineer of the Northwestern Bell Telephone company of Des Moines, Ia., with the aid of an assistant, staged a realistic demonstration showing the effect of inductive interference between power and telephone lines. He had set up a two-wire telephone pole line and placed this alongside a three-wire pole line. These were about 20 feet in length.

By various connections and the pulling of certain switches, the demonstrators were able to reproduce all operating conditions and also the resultant noises upon telephone lines, amplified to make them more dramatic. Mr. Carl lectured on how these contacts come to produce conditions shown, and how by the use of devices in place, the noise on both metallic and grounded lines could be minimized or eliminated.

Deering Speaks of Taxation

C. C. Deering of Des Moines, Ia., national association secretary, detailed what was being attempted at Washington along the lines of taxation of messages, and said that if the ideas were enacted into legislation it would greatly reduce the number of small-priced messages because of the proportionately heavy taxes.

He said President MacKinnon was seeking to postpone the effective date of the order for filing depreciation percentages, because of the expense involved in the breakdown of accounts as now set up, and it was probable that changes would be effected.

Mr. Deering said that the companies have not had so many unusual problems to confront in years. Never before have they lost so many stations. Over a long period it was a consistent record of gains. The year 1930 brought this to a standstill, while during 1931 those who did not record losses were fortunate. These, however, both in number and from the revenue standpoint have been smaller losses than those in most industries and businesses, a fact that he regarded as a tribute to the stability of the telephone business on which owners of it might well congratulate themselves.

"The situation has had redeeming features," he said. "It has compelled company managers to realize the value of sales activity, and the programs laid out have tested their ability to run the plant and sell its service profitably. The telephone has well advertised the fact that few people can afford to be without one when they can pay for one, and at a price so low that it insures more telephones when normal conditions return."

C. R. Moore, from the Bell Telephone Laboratories in New York, gave an illustrated address, devoted largely to some of the work done in the New York laboratories to advance the efficiency of telephone communication, decrease construction and maintenance costs, and add to the safety of employes.

Coulson Discusses Need of Publicity

An interesting address was given by Fred Coulson, secretary and assistant

(*Continued on page* 40.)

Some Physical Characteristics of Speech and Music

By DR. HARVEY FLETCHER
Accoustical Research Director, Bell Telephone Laboratories

(This is the second and last installment of the article by Dr. Fletcher citing various experimental data on the physical aspects of speech taken by instrumental devices evolved in the Bell Laboratories. The first installment appeared in the February issue.)

For describing in greater detail the powers involved in speech, we will define the terms Mean Speech Power, Phonetic Speech Power and Peak Speech Power. They are defined as follows:

The Mean Speech Power is the average speech power within any one one-hundredth of a second period.

The Phonetic Speech Power is the maximum value of the mean speech power of a fundamental vowel or consonant.

The Peak Speech Power is the maximum value of instantaneous power over the interval considered.

It was seen from the oscillographs that the vowels have much greater phonetic powers than the consonants. Studies of these phonetic powers for average conversation have indicated that for a typical speaker they are as shown in Table II. The most powerful sound is the vowel in the word "awl" which carries about 900 times as much power as the weakest sound which is th as in thigh. This most powerful vowel when intoned without emphasis is about 50 microwatts. The relative position in this table depends upon the emphasis given. An emphasized syllable has about three times as much syllabic power as an average one and as will be seen from the table this is about the range of powers among the different vowels.

An analysis of a few oscillograms such as we first considered for determining the peak powers was made and showed that the peak powers are from 10-20 times the phonetic power. It is thus seen that when the vowel in the word "awl" is emphasized, the peak power is from 50 to 200 times the average speech power. To find how frequently these peak powers occur, the apparatus described above using the glow discharge tube circuits was used. The results obtained are shown in Table III.

These values confirm earlier results obtained by oscillographs and give a much more detailed picture of the variation of the peak values as the speech proceeds. About 2 per cent of the time the peak power in 1/8th second intervals exceeds the average power level by 20 db; that is, it is more than 100 times greater. It is seen that a system designed to transmit conversational speech of the best quality should be capable of handling at least 1,000 microwatts instead of 10 microwatts. It is also seen that the most frequently occurring peak is at about 10 times the average speech power. For 21 per cent of the time the peaks are below the average level. A large number of the 1/8th second intervals in this class are silent.

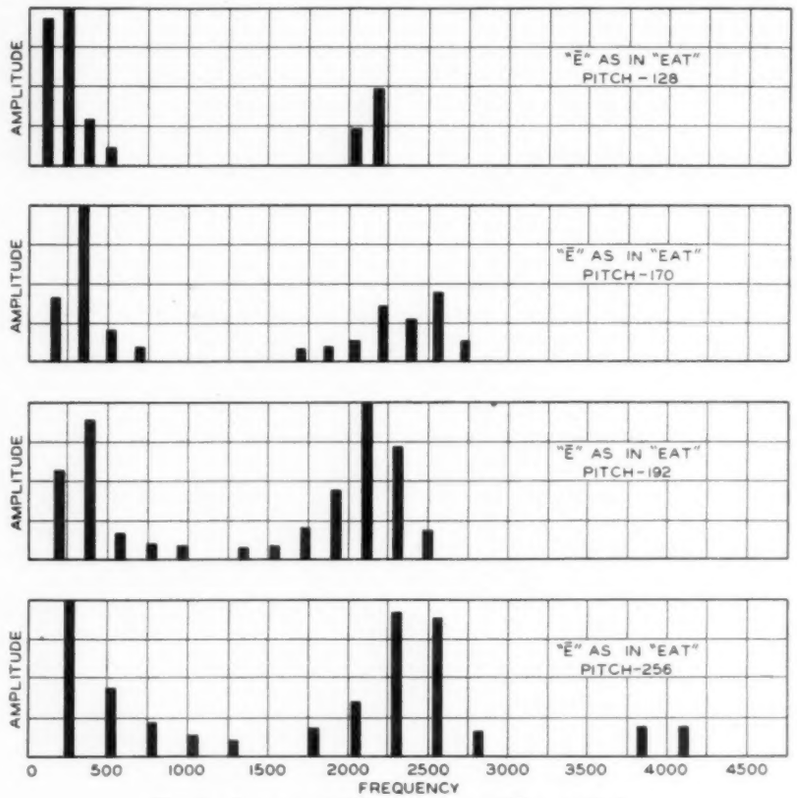


Fig. 9—Spectra of "Ē" intoned at different pitches.

Table II

o'	680	ū	310	ch	42	k	13
a	600	i	260	n	36	v	12
o	510	ē	220	j	23	*th*	11
a'	490	r	210	zh	20	b	7
ō	470	l	100	z	16	d	7
u	460	sh	80	s	16	p	6
ā	370	ng	73	t	15	f	5
e	350	m	52	g	15	th	1

To find how the speech powers are distributed throughout the pitch range similar measurements were made introducing successively each one of the 14 band filters as indicated in Fig. 12. These

$$\text{Fractional energy} = \int_{P^1}^{P^2} SdP.$$

Table III

Per cent of 1/8 second intervals.	Number of db the peak power in the interval is above the average level.
2	above 20
3	18 to 20
6	16 to 18
8	14 to 16
10	12 to 14
11	10 to 12
11	8 to 10
10	6 to 8
8	4 to 6
6	2 to 4
4	0 to 2
21	Below the average

[4] "Speech and Hearing," page 305, and also paper entitled "Absolute Calibration of Condenser Transmitters," by L. J. Sivian, Bell System Tech. Jour., Jan., 1931.

bands were arranged so as to cover about 1/2 octave pitch range except at the two lower octaves where they cover a complete octave. From the measurements on the average speech power in each band the curves in Fig. 15 were constructed. They give the results for average conversational speech for both men's and women's voices. The ordinates are such that the fraction of the total power F which is carried by any pitch interval between P_1 and P_2 is given by

$$F = \int_{P^1}^{P^2} 10^{\beta} dP. \qquad (7)$$

In other words β is the intensity level per octave expressed in bels. For example, the octave containing the most energy in men's voices is —1.75 to —.75 and it contains about $10^{-.5}$ or 31 per cent. The octave below —3 contains about 4 per cent and the octave above +1 about 5 per cent. For women's voices these figures are 31 per cent for the most intense region, which is the octave from —.85 to +.15, and .2 per cent and 7 per cent, respectively, for the other two octaves.

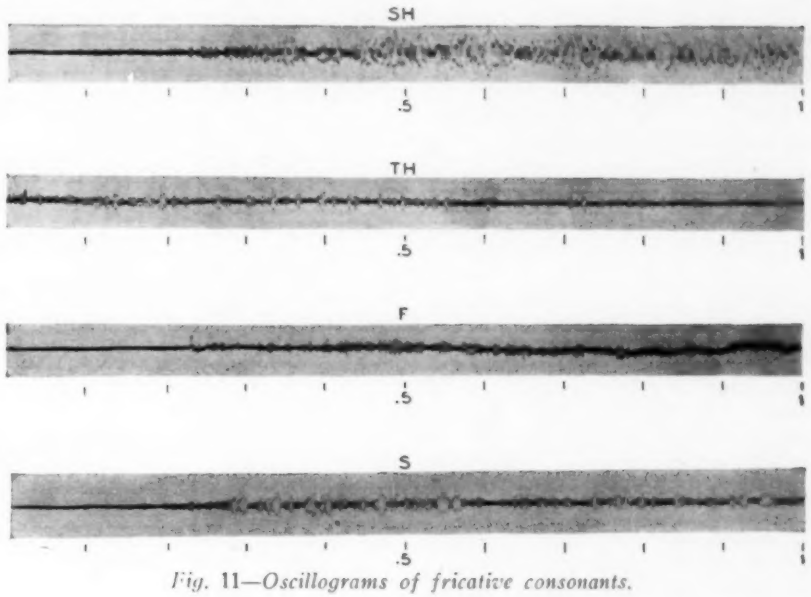


Fig. 11—Oscillograms of fricative consonants.

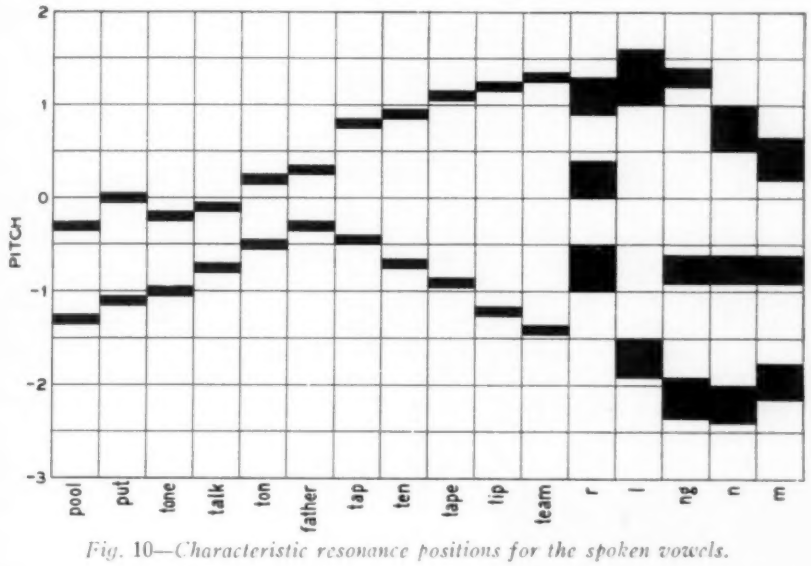


Fig. 10—Characteristic resonance positions for the spoken vowels.

Audible Pitch Limits

The audible pitch limits for conversational speech received at various intensities are determined in the following way. It is seen from Table III that the peak power exceeds the average power by 17 db 10 per cent of the time. The loudness of speech near the threshold is probably determined by these louder components. For convenience the term "effective intensity level" will be used when speaking of these components only. With this nomenclature the effective intensity level is 17 db above the average intensity level. Using these figures and assuming that three-fourths of the speech power is radiated through the hemisphere in front of the speaker, then one can calculate that the effective intensity at one meter's distance will be 6×10^{-3} microwatts per square centimeter or at an effective intensity level of 22 db below one microwatt.

To determine the sensation level the pitches and intensities of the components in the vowels must be considered. A study of the frequency spectra of these vowels indicates that the loudest component contains from 1/2 to 1/5 of the total power of the vowel. From this it is concluded that the components determining the threshold are from 3 to 7 db below the effective level of the speech. The threshold of hearing for pure tones in the pitch region between —1 and +1 octaves is from —85 to —95 db with an average value of —91 db. Consequently, it is concluded that at the threshold the effective intensity level for the speech is approximately —86 db and the average level approximately —103 db. Since the

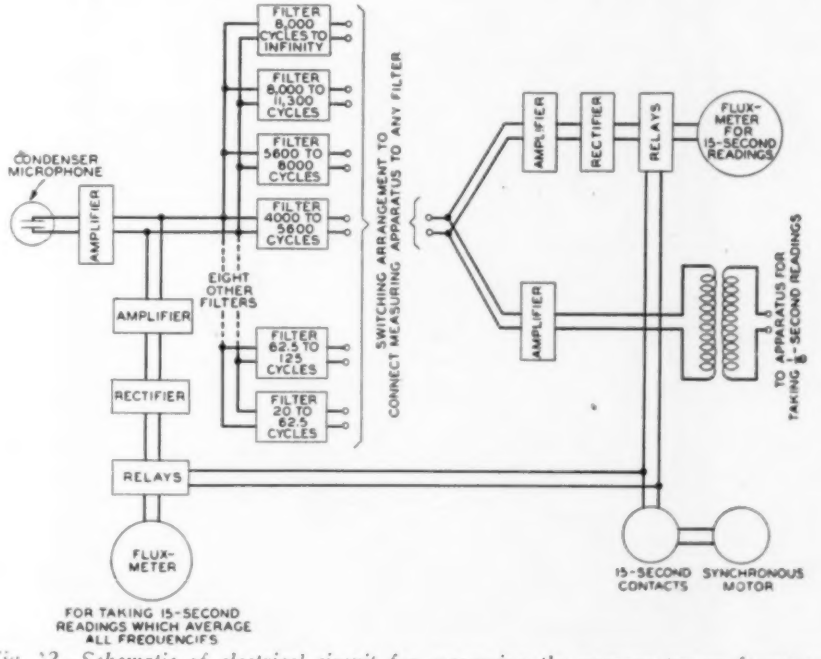


Fig. 12—Schematic of electrical circuit for measuring the average power frequency distribution of sounds.

effective level of the speech at one meter's distance was shown to be —22 db, it is seen that the sensation level at one meter's distance is 64 db. If the speech wave is uninterrupted by reflections then this level decreases 6 db when the distance between the speaker and the listener is doubled. This level will be raised or lowered in accordance with the intensity of the speaking, the variation for different speakers being in accordance with the data in Table I.

For example, using these relations one finds that the most probable average speech power used by a person in conversation is 5 microwatts. The most probable sensation level of such speech at 1 meter's distance is 61 db, at 10 meters' distance it would be only 41 db and could be brought back to level of conversational speech at 1 meter's distance only by the speaker shouting as loudly as possible.

If we use the peak voltmeter as shown in Fig. 13 and make measurements upon the peaks in 1/8th second intervals in each of the half octave bands the results will be as represented by the curves of Fig. 16. The top curves give the maximum level of the peak compared to the average intensity. The other two give levels such that the peak levels are below them 98 per cent, 90 per cent or 75 per cent of the time. It will be seen that the most intense peaks occur in the pitch range of —1 to +1 octaves. In this pitch range the intensity levels of the maximum peaks for the different components are approximately the same, being 13 or 14 db above the average speech level.

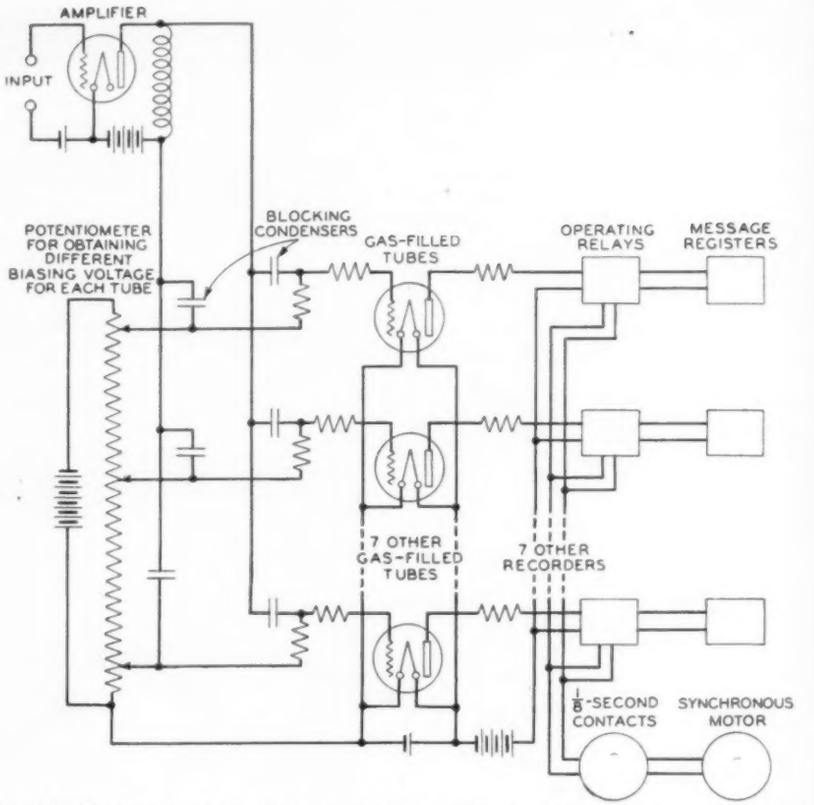


Fig. 13—Schematic of electrical circuit for measuring the peak power-frequency distribution of sounds.

It is interesting to note that in the higher pitch range the curves in this figure are more widely separated than in the lower pitch range. This illustrates an important characteristic of speech, namely, that although components in the pitch range from zero to 2 octaves occur which are just as intense as those in the lower range, they occur less frequently. In other words, the spread in the intensities of the components which are successively occurring as the speech proceeds is very much greater in the higher pitch regions.

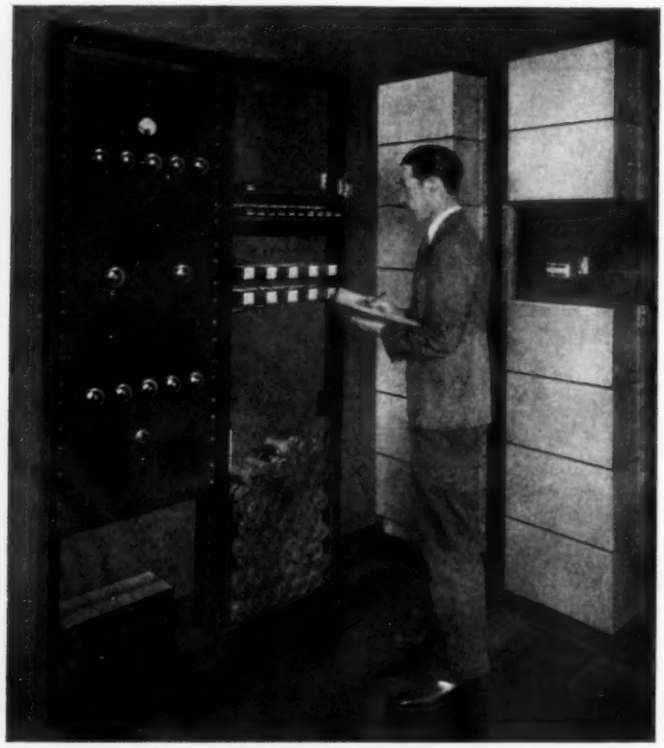


Fig. 14—Photograph of the level analyzer.

As shown above, the threshold is determined for conversational speech when the average speech level is at a —103 db. For the same reason that only 10 per cent of the peaks having the highest levels determined the threshold for the speech as a whole, the curves labelled 90 per cent of this figure can be used as a basis for determining the sensation level in each of the bands. When the ear of the listener is 10 centimeters from the mouth of the speaker the sensation level will be 84 db and the average intensity level will be —19 db. If α_0 is the average threshold level for tones in each of the half octave bands, then, if we subtract α_0 — 19 from each ordinate of the curve in Fig. 16, we will obtain the sensation level of each half octave band. A curve constructed in this way will be called an audibility curve and is given in Fig. 17. This curve is for the case when the lips of an average male speaker are 10 centimeters from the ear of an average listener. It will be seen that the half octave bands above 3.25 octaves and below —4.25 octaves are just audible. If the

distance between speaker and listener is increased to one meter, which is the most commonly used distance, then the audibility curve would be one which is lowered 20 db from that one shown in Fig. 15 and the audible limits would be + 3 and — 3.5 octaves, corresponding to frequencies of 8,000 c.p.s. and 90 c.p.s. Similarly, if the distance is increased to 100 meters, the limits will be found to be + 1.85 and — 1.55 octaves. These relations are true only when no other sounds are present. Similar limits are easily determined when the listener is in the presence of any other sound whose noise audiogram is known. In that case, the ordinates in the audibility curve are reduced by an amount equal to the corresponding ordinate in the noise audiogram.

These values are such that any half octave by itself within the pitch limits will transmit audible sounds. This does not necessarily imply that, when the undistorted speech is acting upon the ear, such a half octave will transmit sounds whose presence can be detected. To test this point several observers listened to speech reproduced by a high quality loud speaker system which would reproduce all frequencies from 40 to 15,000 uniformly and into which filters could be introduced. These filters limited at desired cut-off positions the upper and lower frequencies which were reproduced.

A large group of observers then listened to this reproduced speech and they were asked to judge which was filtered and which was unfiltered. The results of such tests are shown in Fig. 18. The ordinates give the per cent of correct observations and the abscissæ the cut-off frequency of the filter. Taking a 60 per cent correct judgment as a criterion for determining the detectable pitch limits, then it will be seen that the lower limit is — 3.5 octaves and the upper limit 3.25 octaves for male speech which agrees with the results taken from the audibility curve established directly from power measurements upon speech and the threshold of hearing as described above. For female speech the limits are — 2.9 and + 3.4 octaves. Summarizing, then, it is seen that the most powerful components carrying conversational speech, which are of any practical importance, are about 4,000 or 5,000 microwatts while the principal components in the weakest sound carry only about 1/20th of a microwatt. Even for an extremely loud shout or for the most intense singing the maximum power will not exceed more than about 100 times these values; that is, they will not exceed 1 watt. The pitch range necessary for faithfully transmitting men's and women's speech is from — 3.5 to + 3.3 octaves or from 90 to 10,000 cycles per second.

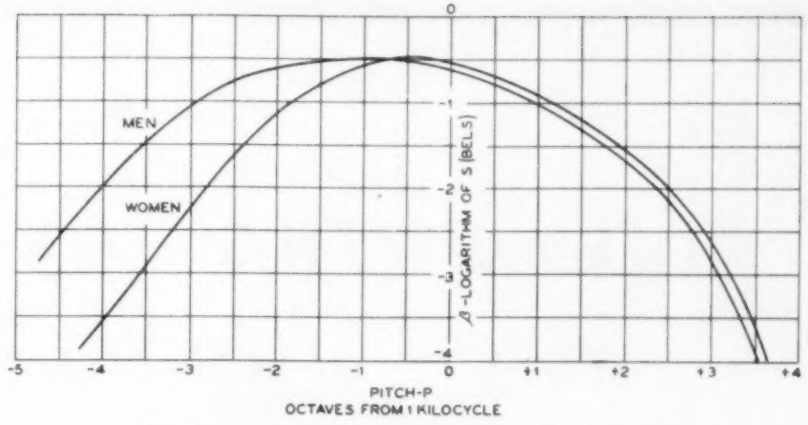


Fig. 15—Distribution function for conversational speech.

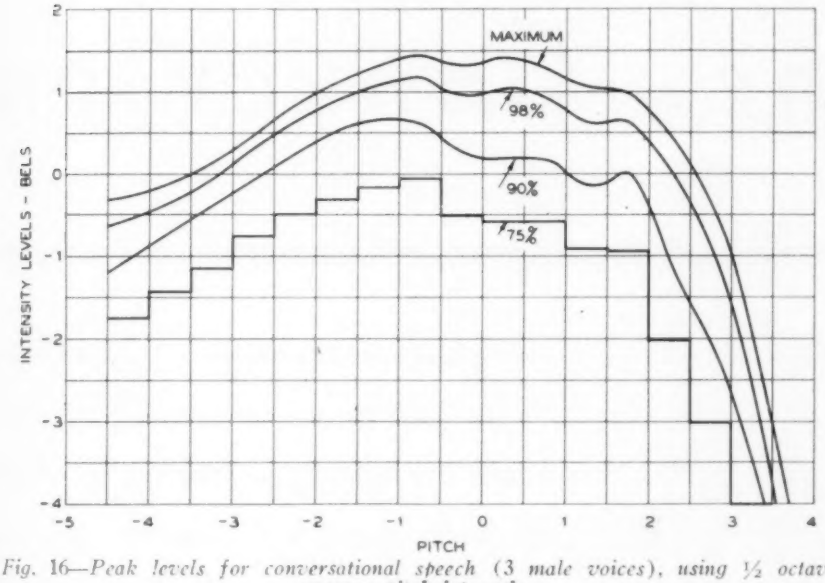


Fig. 16—Peak levels for conversational speech (3 male voices), using ½ octave average pitch intervals.

Acoustical Power Produced by Musical Instruments

Now we will look briefly at some of the same results obtained for music by the use of some of these same measuring tools. In Fig. 19 are shown typical waves produced by the clarinet. A complete oscillogram of the waves produced when the instrument played its full range of three octaves on the chromatic scale was taken. The simple waves shown in the figure are those corresponding to the major triad in each of these octaves. The

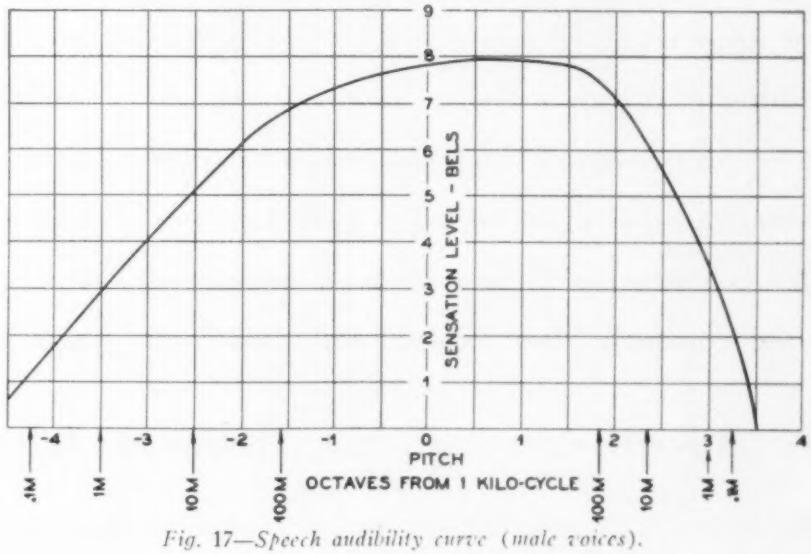


Fig. 17—Speech audibility curve (male voices).

SHOWING ARCHITECTS
THE WHY AND HOW
OF

Telephone Convenien

HOME telephone convenience is born in the architect's blue-prints. His intelligent co-operation is essential from start to finish in the provision for adequate, flexible telephone service.

To enlist this architectural interest, advertisements like the one on the opposite page are appearing regularly in the principal architectural publications. They present the "why" of pre-planned telephone convenience — professional pride in a job well done — a client's enduring appreciation of increased living comfort. They explain the "how" of telephone convenience — conduit incl walls and floors to conceal wiring a vide for telephone outlets at strateg tions throughout the house. And alwa offer the free advisory assistance of t telephone company.

Written simply, directly — illustrat actual applications of telephone conv —this advertising reaches thousands o tects. As they, in turn, plan built-in and outlets for new or remodeled resi the entire telephone industry benefit and connecting companies alike.

An Advertisement of the American Telephone and Telegraph Co

HOMES PLANNED FOR FULL CONVENIENCE HAVE TELEPHONES THROUGHOUT...

Telephone convenience is provided for in the residence of Mr. S. J. Simonson, Stanley Park, Yakima, Washington, by built-in conduit connecting five outlets, including one in the basement. E. G. THERNELL, *Architect, Yakima.*

CLIENTS are pleased when time proves their homes livable, comfortable. And no one factor contributes more to living comfort than adequate telephone arrangements.

You can easily provide for full telephone convenience by planning in advance—by including telephone conduit in the original specifications. Built into walls and floors, the conduit permits time-saving, step-saving telephones to be located wherever they're wanted, throughout the house. In addition, it conceals all wiring, protects against most types of service interruptions, and allows for future expansion to meet changing needs.

When you're planning a new or remodeled residence, consult your local telephone company. They'll be glad to work with you and advise you on the best telephone arrangements for your particular project. There is no charge. Just call the Business Office.

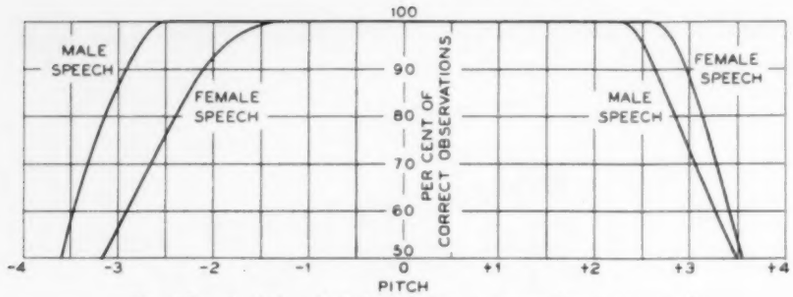


Fig. 18—Audible pitch limits for conversational speech.

entire record was about 250 feet long. Such musical tones have a much more uniform wave form than those from the voice.

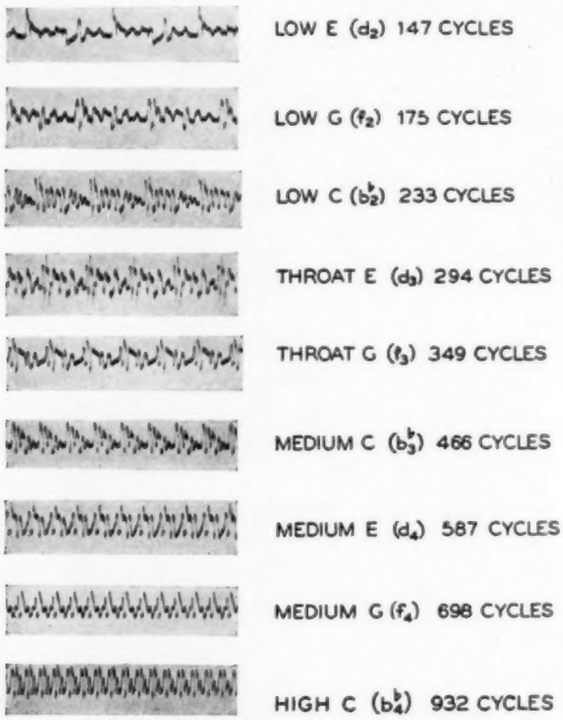

LOW E (d_2) 147 CYCLES
LOW G (f_2) 175 CYCLES
LOW C ($b^\flat_2$) 233 CYCLES
THROAT E (d_3) 294 CYCLES
THROAT G (f_3) 349 CYCLES
MEDIUM C ($b^\flat_3$) 466 CYCLES
MEDIUM E (d_4) 587 CYCLES
MEDIUM G (f_4) 698 CYCLES
HIGH C ($b^\flat_4$) 932 CYCLES

Fig. 19—Major triads of B-flat clarinet.

The measurement of the peak power from typical musical instruments used in an orchestra gave the following results.[6]

The most powerful single instrument is the bass drum which gives powers which exceed 25 watts in successive 1/8th second intervals about 6 per cent of the time it is being played. A 75-piece orchestra playing with full volume will produce peak acoustic powers as great as 70 watts.

When such an orchestra played the four different selections, the maximum peak powers varied from 8 to 66 watts, but the average powers were .08, .07, .07 and .13 watts, respectively. Hence the variation of the average power from selection to selection was much less than that of the peak power. Both the peak powers and also the average powers for the orchestra are about 10,000 times the corresponding powers for conversational speech. In Fig. 20 the curves show how the peak power was distributed among the different pitch bands for this 75-piece orchestra. The curves give the average values for the four selections. The zero line corresponds to a power of approximately 1/10th of a watt. The levels correspond to that which was obtained in the half octave band acting alone. Although the maximum peak was 70 watts for the unfiltered music when the heaviest piece was being played, the most probable peak value in any half octave band is less than 1/10th of a watt except for the octave between —2 and —1 octaves, where it is slightly higher than this value. The distance between the two curves increases as you go to either side of this octave which is approximately that between middle "C" and the "C" above it. This indicates that the components in this region are more nearly alike in intensity and occur more frequently than in the other regions. The top curve indicates that from the standpoint of maximum peak values the half octaves from —2½ to +1½ octaves are all about equally important. As the pitch of a component goes below 2½ octaves, its intensity decreases rapidly as indicated in the figure. Very intense peaks occur occasionally with frequencies as high as 10,000 or 12,000 cycles.

Table IV

PEAK POWER OF MUSICAL INSTRUMENTS
(Fortissimo Playing)

Instrument	Peak Power in Watts
Heavy Orchestra	70
Large Bass Drum	25
Pipe Organ	13
Snare Drum	12
Cymbals	10
Trombone	6
Piano	0.4
Trumpet	0.3
Bass Saxophone	0.3
Bass Tuba	0.2
Bass Viol	0.16
Piccolo	0.08
Flute	0.06
Clarinet	0.05
French Horn	0.05
Triangle	0.05

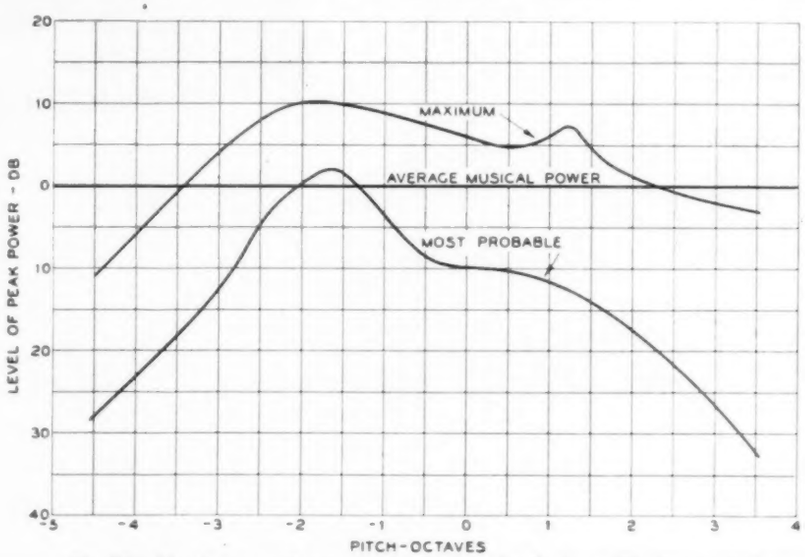


Fig. 20—Maximum and most probable peak levels for a 75-piece orchestra.

[6]These results and those in Fig. 19 were taken from a paper by Sivian, Dunn and White entitled "Absolute Amplitudes and Spectra of Certain Musical Instruments and Orchestras." Jour. Acous. Soc. of America, Jan., 1931.

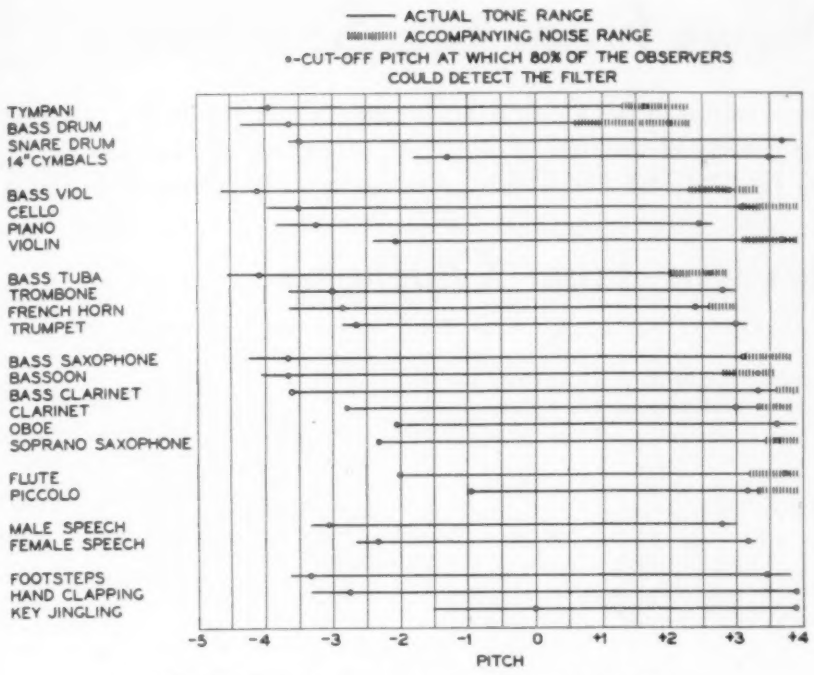


Fig. 21—Audible pitch range for speech, music and noise.

To find the lowest level used in orchestral music a violin player was asked to play as softly as is ever customary while playing before the public. Its average power was found to be about 4 microwatts. It is thus seen that the peak power from a large orchestra is about 20,000,000 times the average power produced by soft violin playing.

Audible Pitch Limits for Musical Sounds

Measurement of the detectable pitch limits was determined in a way similar to that described for conversational speech. The results for typical musical instruments are shown in Fig. 21. For comparison the results for speech and some common noises are also included. It will be seen that the lower limit for music is determined by the bass tuba, the bass viol, and the kettle drum, and its value is about 40 c.p.s. The upper limit is determined by the snare drum, the violin, and the cymbals, and is shown to be about 15,000 c.p.s. Summarizing, then, for music the range of pitches covered by the components is from —4.7 to +3.9 octaves, corresponding to the frequency range from 40 to 15,000 cycles per second. The intensity ranges from about 70 watts to 4 microwatts, corresponding to an intensity level range of 73 db going from the average level of the softest violin playing to the peaks in the heaviest playing of a full 75-piece orchestra.

SIX COMPANIES MERGE WITH NEW YORK TELEPHONE

The following statement has just been issued by J. S. McCulloh, president, New York Telephone company:

"On February 17, 1932, the Northern New York Telephone corporation, the Granville Telephone company, the Otsego and Delaware Telephone company, the Wayne Telephone company, the Alleghany County Telephone company and the Cattaraugus Union Telephone company were merged with the New York Telephone company. All of the stock of these telephone companies has been owned for some time by the New York Telephone company. The New York company has participated in the management of the merged companies in an advisory capacity on engineering, operating, financial and management questions and was represented on their boards of directors.

"The equipment, methods and practices of these companies have been similar to those of the New York Telephone company and little or no change will be made in these respects, or in the personnel. The territories formerly served by these companies are adjacent to the territory operated by the New York Telephone company in upstate New York.

"The merger will add about 56,500 telephones to those directly operated by the New York Telephone company."

ORGANIZE MUTUAL COMPANIES

Mutual telephone companies are being organized by the residents of three Illinois towns, namely: Ladd, Spring Valley, and New Bedford.

HARRY NELSON FARIS

Harry N. Faris, technical engineer for the United Telephone company, Abilene, Kans., died at his home March 3, following an illness of three months, at the age of 52 years, 7 months. Mr. Faris was considered one of the outstanding telephone authorities in the United States, and was admired and respected by telephone men everywhere.

ASSOCIATED DEFERS PAYING DIVIDENDS

At a meeting of the board of directors of the Associated Telephone Utilities company, held March 8, 1932, it was decided to defer payment of the quarterly dividends, payable March 15, 1932, on the $6 and $7 cumulative prior preferred stocks, and the quarterly dividend payable April 1, 1932, on the $6 convertible preferred stock, Series A.

Although earnings accruing to Associated Telephone Utilities company, after paying prior charges and expenses, are more than sufficient to cover dividends on the cumulative prior preferred stocks and on the convertible preferred stock, Series A, and although Associated Telephone Utilities company owns substantial amounts of mortgage bonds and preferred stocks of certain of its subsidiary companies, the directors of the company feel that, in view of the difficulty of marketing such securities under present conditions, it is in the best interest of the stockholders to conserve the cash resources of the company and to defer the payment of dividends at this time.

After learning that the New York Telephone company had charged a charity donation it had made to operating expenses instead of to surplus, the public service commission by a vote of 3 to 1 ordered an investigation into this practice.

Telephone News From the Southwest

Notes of Telephone and Utility Interests in the Central Southwest Which Previously Were Reported for Transmitter and Electrical Journal, a Regional Magazine of that District Which Has Been Absorbed by TELEPHONE ENGINEER, Appear in the Following Columns

Observations From Oklahoma

Improvements to System at Erick

The Southwest Telephone company will make improvements to its system at Erick, Okla., to cost approximately $18,000. These will include installation of local and toll line systems and a full metallic toll line to Texola. Facilities will provide for connections between the Erick and Texola exchanges.

Postpone Depreciation Reports

H. W. Hubenthal, Oklahoma City, engineer, Oklahoma Utilities association, has been notified by F. B. MacKinnon, president, United States Independent Telephone association, that the latter association has filed a formal request with the Interstate Commerce commission asking that the final date for depreciation accounting reports of A, B and C telephone companies be extended one year, or to September 1, 1933.

The order is to become effective January 1, 1933, and requires all A, B and C companies, or those having an annual gross income of $50,000 or more, to distribute their plant and equipment accounts to the primary accounts required by the order and to file their depreciation percentage rates with I. C. C. through their own state commission by September 1, 1932.

Reasons assigned by the United States Independent Telephone association for asking postponement are that financial conditions make it difficult for telephone companies to meet the expense incidental to the accounting and engineering required in connection with the filings this year, and that logically the new system of accounts should be in effect and the companies have their books and accounts adjusted in accordance with the requirements of that system before filings are made.

Ask Rate Reduction at Coyle

Tom Cheek and others of Coyle, Okla., have filed an application with the Oklahoma Corporation commission, seeking a reduction of rates by the Southwestern Associated Telephone company at Coyle, Okla.

Miss Gregg Receives Award

Miss Anna Mae Gregg, chief operator for the Southwestern Bell Telephone company at Clinton, Okla., has been awarded a service pin and extended congratulations by company officials for ten years of efficient service with that company at Clinton.

Rebuild System at Lamont

The telephone system at Lamont, Okla., will be rebuilt at a cost of between $1,200 and $1,500. The Oklahoma Gas & Electric company has donated a number of poles which were formerly used by that company.

Customer-Ownership Campaign

The Western Telephone corporation during the weeks from February 22 to March 5 was engaged in its semi-annual customer ownership campaign. Employes of the company are distributing the securities. An interesting feature of this year's sale is that the shares are being offered during the short period at a price to yield over eight per cent. This, it is explained, has been due to market conditions which have affected all securities, resulting in the offering of attractive investments.

State Settles Suit Against Bill

A suit of the state of Oklahoma, filed against the Southwestern Bell Telephone company, attempting to collect $644,000 for alleged taxes to the state, was settled February 9 by an agreement between the company and Attorney General J. Berry King, by which the telephone company pays the state $44,795.94. The original suit sought to collect taxes on the capital investment of the company in the state since 1920, amounting to $33,000. This settlement saves the company penalties of $25 per day since 1920. The company contended that this tax was not legally collectable because of the interstate nature of its business, but made the compromise offer to pay the tax with six per cent interest in order to show a spirit of co-operation with the state.

New Exchange Building in Bowlegs

H. P. Simpkins, manager, Bowlegs Telephone company, announces that his company will construct a new building immediately in Bowlegs to house the exchange. Cables will be run from the present exchange to the new building, which will result in better service.

Tulsa Sues Southwestern Bell

The Southwestern Bell Telephone company has filed a demurrer to the suit recently filed by the city of Tulsa seeking $800,000 from the company for use of streets and alleys over a nine-year period. The company contends in its demurrer that the secretary of the interior in the early days granted the Southwestern telephone company permission to operate in what was then Indian territory and that the grant has never been revoked. This grant, the company contends, excludes the city from the right to collect the amount.

Blind Telephone Operator at Welty

A recent story of a blind telephone operator in an eastern community recalls the fact that Oklahoma also has a telephone operator similarly handicapped in the person of H. K. Taylor. He can manipulate the party line calls on his rural switchboard at Welty, Okla., as deftly as any nimble-fingered telephone girl. He not only runs the switchboard, but directs the operation of the Welty exchange and makes a comfortable living for his family, although totally blind.

Operator Prevents Jail Break

Miss Louise Bradley, telephone operator at Miami, Okla., may be awarded a medal for her action recently in preventing a jail break in her city. When prisoners overpowered C. A. Guffy, he knocked the telephone receiver from the hook. Noticing the signal and getting no response Miss Bradley called Sheriff George Payton at his home and the police station. Officers arrived in time to prevent the prisoners' escape. An effort will be made to secure for Miss Bradley the Vail Award given telephone company employes for outstanding heroism.

At the annual meeting of stockholders of the Hanska Rural Telephone company, Hanska, Minn., it was announced that the stock that had been sold to the Pioneer Telephone company has been re-purchased and the utility is again home-owned. The concern had 394 telephones in operation December 31.

VACUUM TUBE THEORY AND PRACTICE

SUBJECT: SOUND PROJECTION PRACTICE—PART II

General

The October issue of TELEPHONE ENGINEER carried the first of a series of arti-

Fig. 1—Universal model BB two button carbon microphone manufactured by Universal Microphone Company.

cles dealing with sound projection practices with special reference to the revenue possbilities in this type of work for Independent Telephone companies.

This is the second article of the series and covers some of the general features of public address installations.

The term "Public Address Installation" refers to the various units such as microphones, amplifiers, projectors, etc., which are used to make audible to a large number of people the voice of a speaker, or music which may be either picked up directly or obtained from wax records.

Public address service can be sold to fairs, chautauquas, athletic events, indoor affairs, dance halls, large picnics, in fact it is a desirable service wherever large groups of people gather together for the purpose of entertainment.

Telephone companies are the logical ones to sell this type of service inasmuch as the erection of poles, wire stringing, and the use of cable facilities is often required, and no one is better equipped to do this type of work than the local telephone company.

The price of public address equipment is sufficiently low at the present time, for a few hundred dollars to provide an excellent, high quality system, capable of taking care of any event such as is usually encountered in the small town.

Public address equipment is not nearly so complicated as the average radio, however, the fact that a large number of people will judge the grade of service rendered, makes it imperative that the technical details of operating public address equipment be thoroughly understood, by those in charge. Otherwise poor results may be obtained which will tend to curtail the demand for public address service in a community.

Items of Equipment

A public address system consists of the following essential units, viz.:

1. The microphones and phonograph pick-up equipment.
2. The microphone amplifier.
3. The power amplifier.
4. The projectors (loud speakers).

In addition to the main items listed above equipment for controlling the microphones and phonograph pick-up, and for measuring the output level into the projectors, is required.

The microphones ordinarily employed for public address work are of the two button variety such as the universal microphone shown in figure 1. Such microphones transmit a band of frequencies sufficiently wide to give good reproduction of speech. Where exceptionally high quality is required a condenser

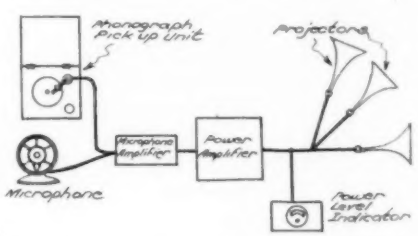


Fig. 2—Essential units of a public address system

microphone is used although there is seldom much occasion for extremely high quality on public address jobs of the outdoor type.

The volume output of two button carbon microphones is much lower than that of ordinary single button telephone transmitters (from 20 to 30 db down) and it is therefore necessary to amplify the feeble voice currents from the two button microphone before feeding them into the power amplifier which is used to drive the several projectors which are generally used. For this purpose voltage amplifiers having overall gains of from 25 to 50 db are generally used. Such amplifiers consist usually of two stages of tandem coupled amplification.

Amplifiers and Projectors

Power amplifiers are required to provide the large amount of power necessary to operate a number of high level projectors. The chief difference between the microphone amplifier and the power amplifier is in the size of tubes employed and the magnitude of plate voltages and currents.

Projectors such as are used in connection with public address systems are but little different from the magnetic and dynamic types of speakers employed in home radios. The principle difference is in the use of trumpet type horns, with the operating units designed to stand much higher levels without distortion or break down.

Figure 2 illustrates schematically the essential components of any public address system, while figure 3 illustrates how these units might be located in a typical installation.

The power level indicator shown in the figure is merely a voltmeter of the vacuum tube type or one of the new rectifier type meters. The scale instead of reading in volts is calibrated to read decibels with respect to a standard zero reference level.

In order that a good understanding of the characteristics of each of the component parts of a public address system be obtained it will be desirable to discuss in detail each of these items.

Characteristics of Microphones

The essential parts of the two button carbon microphone are shown in figure 4. It will be noted that the two button microphone differs from the familiar telephone transmitter in two important respects, viz., it has a very thin stretched duraluminum diaphragm, and it has an additional carbon button and bridge. The resonant frequency of the stretched diaphragm is well above the frequencies required for good quality speech and it is placed very close to a solid metal plate

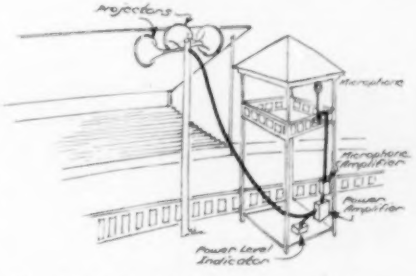


Fig. 3—Typical public address job (county fair)

so that air damping is obtained by the motion of the diaphragm acting on the film of air between the metal plate and diaphragm.

The two carbon buttons are located one on each side of the diaphragm and act

in such a manner that the distortion due to one button will be canceled by equal distortion in the opposite button. This is often referred to as push-pull operation. The average resistance of each of the buttons is about 100 ohms in most types of two button carbon microphones. Such a microphone should therefore be worked into a 200 ohm impedance for best results.

The portion of the diaphragm with which the carbon granules make contact is covered with a thin coating of gold in the better grade of microphones. This "gold spot," as it is sometimes called, is obtained by a sort of welding process (Western Electric) and by pressing pure gold spots on under high pressure in the case of the Universal Microphones illustrated in figure 1.

The purpose of the gold spot is to offer a low resistance contact surface to the granular carbon. For general utility public address work the Universal Model BB is particularly well adapted. Microphones are relatively inexpensive at the present time whereas a few years ago the cheapest units were over $50.00. Microphones such as the one illustrated in figure 1 are more available to telephone companies at a net cost of about $15.00.

Care of Carbon Button Microphones

High quality two button transmitters must be handled much more carefully than ordinary telephone transmitters, otherwise they may be easily ruined. It is especially important that they be protected against jars and mechanical vibration. In order to protect them they are usually suspended in a metal ring and supported by eight small springs.

Three general types of microphone holders are available and are known as the desk type, banquet type, and floor type.

Two button microphones operate on much lower current values than ordinary telephone transmitters. The maximum and minimum current per button will depend on the make of the microphone. In general the individual current should not exceed 45 milliamperes for Western

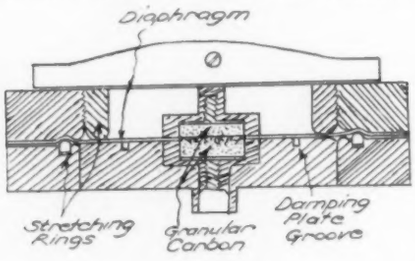


Fig. 4—Cross section view of two button microphone

Electric microphones, or 10 milliamperes on Universal microphones.

Microphones such as the Universal Model BB illustrated in figure 1 may be operated from a single flashlight dry cell.

It is desirable that the current flowing to each button be nearly the same. However, too much importance should not be attached to variations between the button currents where the difference is not over 20 to 25 per cent of the current in the higher button.

Difference in current flow to the two buttons is due partly to the fact that one button is sealed behind the diaphragm while the other is open to the atmosphere where it is subjected to changes of temperature and by moisture. When current is first turned on the button currents may show a decided unbalanced condition but after a few minutes' use they gradually become equalized.

Moisture is a natural enemy of microphones, and they should be used and kept in a dry place. If buttons become packed, due to moisture, or long standing in one position, they may often be restored by the following procedure: Hold the microphone in one hand with the diaphragm in a horizontal position, first face up and then face down, striking one hand gently with the other. Revolving the unit will also help.

Under no circumstances should the microphone be handled and moved

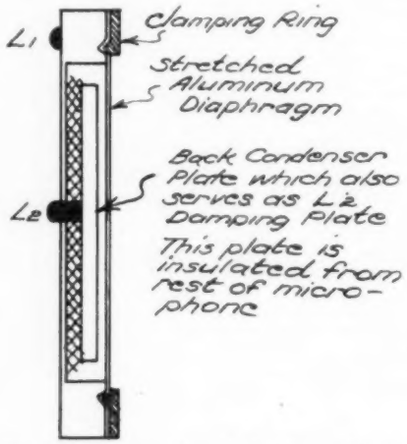

L1
Clamping Ring
Stretched Aluminum Diaphragm
Back Condenser Plate which also serves as L2 Damping Plate
L2
This plate is insulated from rest of microphone

Fig. 5—Cross section of simple condenser type microphone

around when the current is on as the carbon granules may be damaged.

Microphone Sensitivity

Microphones can be obtained in several degrees of sensitivity and the microphone to select or use for a particular installation will depend upon feedback conditions and the location of the speaker or sound source with respect to the microphone.

The Universal Microphone company, for example, offers its various standard models in three degrees of sensitivity, viz.: (M) Medium, (S) Extra Sensitive, and (D) Damped. They recommend the medium sensitive microphone for standard use, the extra sensitive model for use where extreme sensitivity is required and where there is little acoustic coupling or feedback, and their model D (damped) where excessive background noise is present and where excessive feedback (acoustic coupling) between projectors and microphone is liable to take place with the more sensitive types of microphones.

The Universal Model D is best suited for close talking where the speaker is directly in front of the microphone and his lips only a few inches away.

Microphones that are highly damped

Fig. 6—W. E. condenser microphone

generally have much better frequency response over the entire voice range than do other types. However, greater amplification is required where the highly damped type is used.

All carbon microphones have a certain amount of "carbon hiss" when in operation. This is a noise effect heard in the projectors which sounds very much like someone was blowing or hissing in the microphone. It is thought to be due to heating at the contact between the carbon granules. Prominent engineers have explained the effect by stating that a certain amount of gas is contained in the pores of the carbon contact surfaces, and when current passes through the button, the increase in contact temperature which results, causes a portion of this gas to be driven off which produces changes in resistance which gives rise to the familiar carbon blow or hiss.

By proper operation of carbon button microphones this effect is not troublesome, especially when the level of the sound input to the microphone is fairly high.

Condenser Microphones

Where exceptionally high quality programs are to be handled on public address or any type of sound projection equipment, the condenser microphone is preferred to the carbon two button type.

The condenser microphone consists essentially of two plates placed extremely close together but insulated from each other. One of the plates (back plate) is a rigid plate and the front plate is composed of a very thin diaphragm of aluminum alloy sheet. The edges of this diaphragm are clamped between threaded rings, and by means of a stretching ring

(*Continued on page* 40.)

Telephone Activities in Foreign Countries

Dispatches from Abroad Keep Telephone Men in United States Constantly Informed Concerning Telephony of the World; Domestic Telephone Problems Oftentimes Can Be at Least Partially Solved by Watching the Outcome of Experiments Made Elsewhere

Telephone Systems in Netherland West Indies

Prior to 1927 there was in Curacao a private company operating the telephone service at Willemstad under a franchise. When this franchise expired in 1927 it was determined to construct an entirely new telephone system with government funds. This plant was completed in 1928 and began operations in February of that year. There is one exchange with a capacity of 800 instruments. There are at present 585 subscribers. There is no central power system and subscribers ring by hand magnetos.

The telephone system at Aruba is also operated as a department of the government. The equipment at Aruba consists of a panel with capacity for 100 telephones, and there are already 100 subscribers on that island.

On the other islands of the Netherland West Indies, Bonaire, Saba, St. Martin, and St. Eustatius, there are no public telephone systems. On each island there is a line from the residence of the chief executive to the police stations, but it is not a public service and there are no private subscribers connected.

Extend Radio Service to Airplanes in Czechoslovakia

Since February 16, 1931, it has been possible to send private radio messages to passengers on planes on the Berlin-Dresden-Prague-Vienna air line. This service has proved so satisfactory that the Czechoslovakia Ministry of Posts and Telegraphs is planning to extend it to other lines this year.

Syria Plans Installing Adequate Telephone System

The high commission is reported to have approached the various state governments under Mandate concerning the desirability of installing an adequate telephone system throughout Syria. Three propositions are said to have been submitted to the various governments by the commission. (1) The grant of the concession to a foreign enterprise for exploitation on a commercial basis; (2) the merger of the telephone service with the present post and telegraph administration; and (3) the creation of a local administration for the exploitation of the telephone, to the profit of the individual state.

"Les Echos de Damas" affirms that, after having studied these three projects, the State of Syria, the largest under the Mandate, has advised the acceptance of the third. The enterprise is valued at 70,000,000 francs (about $2,725,000).

Establish Telephone Service Between Persia and Iraq

It is announced that an agreement has been reached between the governments of Persia and Iraq regarding the establishment of telephone communication between the two countries. A commission, which will have the assistance of foreign experts, has been appointed to complete the necessary technical details.

Two More Automatic Exchanges in Paris

In the presence of French Telephone administration officials, two rotary automatic officers, "Archives" and "Turbigo" were placed in service in the Paris area recently. These exchanges represent part of a comprehensive program which was formulated five years ago by the French Telephone administration and which calls for complete automatization not only of the Paris area but of all the important cities of France. Conversion to automatic or dial working in the French capital was started in 1928. It was estimated that by 1938 there would be 675,000 telephones in Paris and its suburbs, when the automatic system would be used throughout.

The new exchanges are equipped for a total of 16,000 lines. Parisians now have 12 automatic exchanges in the Paris area, and with the opening of the additional exchanges, approximately 50 per cent of the present telephones are automatic.

Automatic Telephone Service Available in Istanbul

A further step in the modernization of Turkey is the opening of automatic telephone service in Istanbul. The exchange, operated by the Constantinople Telephone company, is located in Stamboul, the main business section of the city. The initial installation is equipped for 4,800 lines and is the first stage of completely equipping the Istanbul area with automatic telephones.

Ethiopian Telephone System

Telephones were first introduced in Ethiopia about 1896. There are only three real exchanges now in active and regular operation in Ethiopia, all located in Addis Ababa. Two are for Government service and the third is public. The exchange in the main imperial palace has 60 lines and a switchboard capacity of 100 telephones. The other Government exchange, in the second or royal palace, has 30 lines and a capacity of 50 instruments. The third or public exchange is installed in the Post Office building and is controlled by the Ministry of Posts, Telegraphs and Telephones. It has two switchboards, each of 100 numbers capacity, the present number of subscribers being 150. All switchboards and 80 per cent of all instruments, batteries and accessories in Addis Ababa are of Swedish manufacture.

Rates: A telephone is installed within or quite near the city for MT$150 (US$37.50). Outside the city, beyond the range of existing wires, the cost is increased in proportion with the cost of new poles, wire, etc., and, of course, divided proportionately if the telephones installed at the same time use the same new line. Subscription rates are MT$10 (US$2.50) monthly for the first telephone of a given subscriber and MT$5 (US$1.25) is charged monthly for each additional telephone rented to the same person, even if in different parts of the city. This rate may be soon increased. The whole traffic relatively moderate, however, in Addis Ababa it is steadily increasing and is at present about as heavy as existing facilities can well carry.

Wireless Telephones for British Lifeboats

The Board of Trade inquiry into the yachting accident, in which a prominent member of Parliament and five companies were drowned last year, will probably result in extensive developments in wireless telephone communication between all parts of the British coast. It is considered very probable that the report of the inquiry in question will recommend the linking up of every part of the coast by wireless telephone, and the patrolling of the coast during stormy weather by fast lifeboat cruisers, equipped with wireless telephones.

THE TECHNICAL CLEARING HOUSE

B. C. BURDEN, Editor

One Way Amplifiers for Boosting Voice Currents

Q.—We have a long metallic iron toll circuit on which the transmission is very poor and would like to know if some form of audio amplifier could not be improvised to amplify the weak incoming voice currents?

A.—Unfortunately the vacuum tube is a "one way" device, that is, it amplifies in one direction only. Any attempt to connect two one-way amplifiers so that one will amplify in one direction and the other in the opposite direction results in audio squeals so that it is impossible to get any gain from the amplifiers. The audio "squeals" result from the fact that the input and output circuits are coupled directly together and therefore operate in a similar manner as a vacuum tube oscillator.

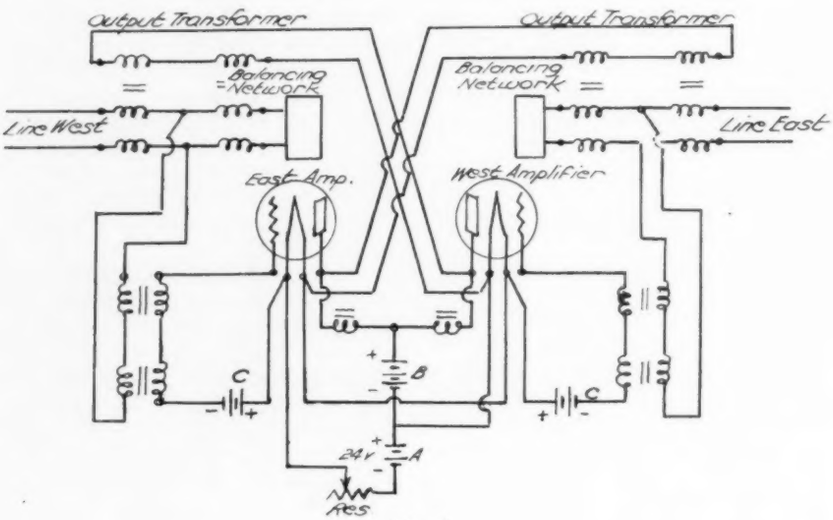


Fig. 1

The only way to connect vacuum tubes so that they may provide two way amplification in metallic circuits is by means of a special three winding transformer and a circuit similar to that shown in figure 1. This is the basic repeater circuit used on long distance lines in this country.

The successful operation of such an amplifying arrangement depends on the balancing network having approximately the same impedance characteristics as the line to which it is connected. When this is the case zero voltage is induced across the input circuit of the east to west amplifying tube when the transmission is from west to east, likewise when the east subscriber is talking to the west subscriber there is zero voltage induced across the grid circuit of the west to east amplifying tube. It is obvious that such a circuit is a modified form of the familiar wheatstone bridge circuit.

Inasmuch as repeaters are fully covered by patents, home-made repeaters even though they might be improvised so that they would work satisfactorily, could not be used on commercial toll lines.

Rebuilding Transmitters

Q.—Can old transmitters be rebuilt by the small Independent telephone company so that they are as efficient as new transmitters?

A.—The rebuilding of transmitters involves principally the replacing of defective parts and the recharging of the carbon cup with new carbon. Where the carbon electrodes are pitted or have lost their high polish they must either be replaced or repolished. The principle difficulty in rebuilding transmitters is in getting the correct amount of carbon in the cup and in obtaining a good grade of carbon which is suitable for use in the particular transmitters being rebuilt. It is doubtful whether the small company can economically rebuild old transmitters bearing in mind the present low prices quoted for this class of work by the repair companies that make a specialty of transmitter repair.

Power Level Indicators

Q.—Commercial power level indicators which are available for use in transmission testing are calibrated directly in decibels. What is the reference level ordinarily used in calibrating these instruments.

A.—Commercial level indicators such as those manufactured by the General Radio company use a reference level of .006 watts. This level is approximately 10 decibel higher than the reference level used in setting up transmission standards. A reference level of .006 watts is equivalent to a voltage of 1.73 volts across 500 ohms.

Surveyor's Level

Q.—For what purposes are a surveyor's level used in outside plant construction work?

A.—A level or semi-transit type of surveyor's instrument can be used for lining up new pole leads, lining up conduit trench, and for collecting elevation data of the route of a proposed conduit run for use in preparing a profile map.

Levels are available which are of the convertible type, i. e., permit swinging the telescope on its horizontal axis, at prices as low as $40.00.

For the company involved in much outside pole line building, a level is a very convenient tool that will pay its own way.

Transmission Measurements

Q.—What is the approximate cost of a complete transmission measuring kit by means of which losses of lines and equipment can be accurately evaluated in terms of the decibel?

A.—A very excellent transmission measuring kit can be made up for around $55.00. All that is required is one General Radio 1,000 cycle oscillator, and two General Radio or Weston rectifier type meters. One of the meters should have a range of 0-5 volts, and the other a range of 0-1 volt (2,000 ohms per volt).

LINCOLN HAS VETERAN EMPLOYES

The Lincoln Telephone and Telegraph company, has a unique employment record. More than four hundred employes have been in the company's service for a period of five years or more.

Not including its connecting telephone companies, the Lincoln Telephone and Telegraph company had on August 31, 1931, 1,296 employes. Of these 410 have a service record of five years or more, and of this group 233 have served from five to ten years, 98 from ten to fifteen, 37 from fifteen to twenty, 26 from twenty-five, and 16 real veterans have been with the company more than twenty-five years.

Washington, Mo., Gets Common Battery

Stromberg-Carlson Installs Central Office Equipment Including Four Position Switchboard in New Plant of Exchange Belonging to Scotia Telephone Company

By P. WINEMILLER
Sales Engineer, Stromberg-Carlson Telephone Mfg. Co., and
J. P. GALLIGAN
Missouri Representative, Stromberg-Carlson Telephone Mfg. Co.

The Scotia Telephone company, St. Louis, Mo., of which P. Kerr Higgins, a man well known to all in the telephone industry, is president and general manager, owns and operates numerous exchanges in the eastern part of Missouri, Oklahoma, and Texas.

It being the policy of the Scotia company to keep all of their exchanges in first class shape and to give the best possible telephone service, they have just finished the complete rebuilding of their Washington, Mo., exchange—this rebuilding applying not only to the central office equipment, but to the entire outside as well.

Switchboards and associated equipment together with all instruments were furnished by the Stromberg-Carlson Telephone Manufacturing company.

As will be noted by referring to the photographs, the switchboard consists of four positions, each position being a unit in itself and of the well known Stromberg-Carlson No. 3 steel frame sections. The local lines, arranged in an associated multiple, employ the use of the standard Stromberg-Carlson 190 type line and cut-off relays, of which there are now more than 125,000 sets in actual operation.

This 190 type relay was developed by engineers of the Stromberg-Carlson company and placed on the market in the year 1912. At the time of its introduction, it was such a departure from the old conventional type line and cut-off relay that it caused considerable comment. Being such a decided step forward, the telephone operating people were a little slow to consider it.

Past history has proven that it was the forerunner of the most outstanding improvement made in the design of telephone relays. Its past performance is a positive guarantee of what may be expected from it.

All toll and rural lines are lamp ended, the rural lines being so arranged that code rings on the line are faithfully indicated to the operators. The toll lines appear in front of the toll operating position only while the rural lines are accessible to all positions, there being lamp and jack multiples of these lines, making them available to all operators.

Incorporated in rural lines are features which make it possible for them to be inter-connected either to other rural lines or to local lines with the use of simple local cord circuits only. There are no universal cord circuits on the board, with the exception of those in the toll position, which are of the high efficiency type, employing the use of 48 volts on local connections.

The local cord circuits employ the following features, which are standard with the Stromberg-Carlson company:

P. Kerr Higgins, President and General Manager of the Scotia Telephone Co.

Machine ringing, reverting tone, instantaneous generator cut-off, flashing recall and secret service on local to local and rural to local connections.

These features provide means for quick handling of traffic under all conditions and, at the same time, it is unnecessary to instruct the telephone user as to the proper way in which to satisfactorily complete his call, there being no way in which he can inadvertently destroy his connection. While this equipment is new to the Washington operating force, they have already handled considerably over 300 calls per position per hour.

All cord circuit equipment is mounted on swinging relay gates in the rear of the sections. In fact, all of the labor in connecting relays, condensers, repeating coils, keys and associated equipment of the cord circuits was performed in the

New Stromberg-Carlson switchboard installed by the Scotia Telephone Company, at Washington, Mo.

factory before shipment of the switchboard was made, with the result that the installation cost was exceedingly low.

The main frame and line relay equipment is assembled on one of the standard combination frames originated by the Stromberg-Carlson company. With this arrangement the apparatus is not only accessible but considerably less floor space is required in the terminal room.

The power equipment is of ample size to carry the load of the present installation for a period of 48 hours in case of a power failure and to function perfectly if the ultimate number of lines (1600) are installed.

The power board consists of two slate panels, 24 by 30, which provides adequate space for mounting all of the necessary switches, relays, meters, coils, etc., used in connection with the power set-up. Provision is made for automatic charging of the main battery, employing the use of a sangamo watt hour meter, which, by noting the photograph of the power board, is placed directly between the full size Weston volt and ampere meters on the face of the power board, thereby allowing the attendant to accurately judge the condition of the power equipment by simply glancing at these closely associated meters.

In connection with this ampere hour meter, there are provided the very necessary alarms, both audible and visible, to advise the attendant in the event of an AC power failure, tube failure, or the operation of protection fuses, etc. The main battery consists of 11 cells of the Electric Storage Battery company's E.M.G. 0.9 chloride accumulator cells. The toll booster battery is also of the chloride accumulator type and consists of 11 CTM. units. Both of these batteries are of the improved, sealed and spray-proof type.

Facilities for charging the main battery consist of a 12 ampere full wave Tungar rectifier in conjunction with the above mentioned ampere hour meter and a half ampere noiseless type Tungar rectifier for the booster battery.

Ringing current is derived from standard Stromberg-Carlson 1-B converters, in connection with two Holtzer-Cabot motor driven interrupters; one to operate from 110 volts AC and one from 24 volts DC.

The Washington installation is complete in every detail and one of which the Scotia Telephone company, as well as the Stromberg-Carlson company, is justly proud. Although there was a substantial increase in the subscribers rates at the time this equipment was cut into service in May, there was but one telephone taken out up to December 1st.

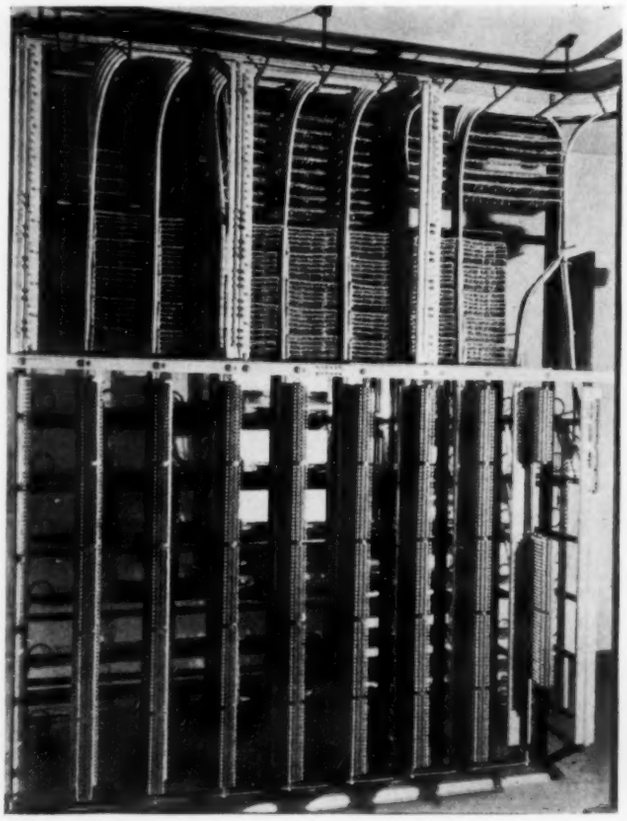
However, there was a net gain of 74 new subscribers during the same seven months period after the new service was inaugurated. This tells a story which should be of vital interest to operating executives, as it has been demonstrated time after time that a healthy net gain in stations can be directly attributed to improved service and especially so coincident with the conversion of a magneto system to up-to-date common battery.

The local manager of the Washington exchange, Hugo Palisch, states that since the installation of this new Stromberg-Carlson equipment he has had nothing but words of praise from his subscribers. The service is fast, reliable and sure and, as stated in the aforepart of this account, has resulted in an increase of subscribers.

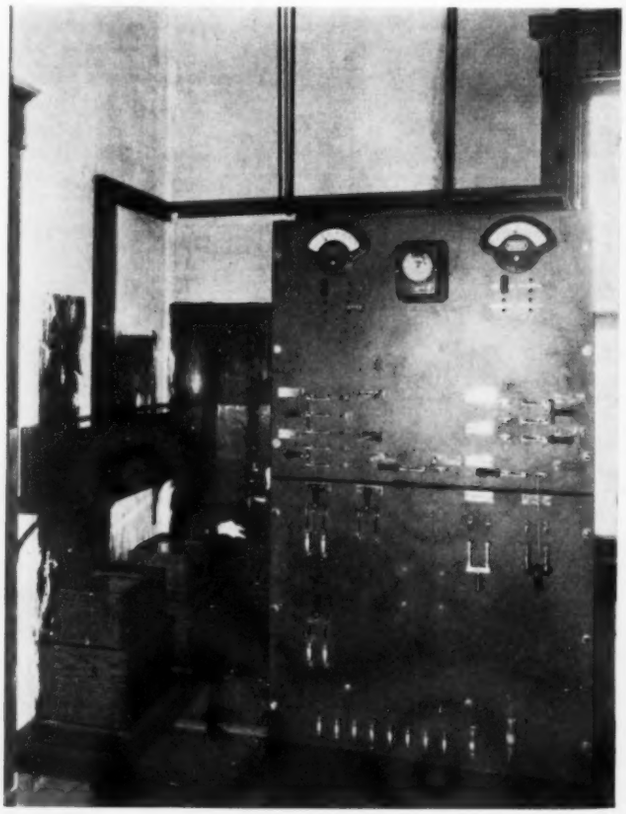
Mr. Higgins has been in the telephone business in the United States and foreign countries for a period of over fifty years. He is a native of Scotland and the accompanying photograph shows how well he can wear the regalia so dear to Scotland; namely, the "kilts."

Mr. Higgins' long years of service in the telephone business places him in a position to rightfully judge efficient telephone apparatus. He is president of the Port Arthur Telephone company of Port Arthur, Texas, where he is operating a 5,500 line Stromberg-Carlson switchboard. He also has Stromberg-Carlson equipment in operation at Coweta, Oklahoma, and Eldon, Mo.

The local telephone office at Davenport, Okla., has been moved to new quarters.



Stromberg-Carlson main frame and relay rack in the Washington, Mo., exchange of the Scotia Telephone Company



Power equipment in the Washington, Mo., exchange of the Scotia Telephone Company.

Advertising Is Theme of Iowa Convention

President Mellick in Annual Address and Other Speakers, Too, Advocated Increasing Advertising as Principle Method of Keeping Present Subscribers and Gaining New Ones; Telephone Conditions in Rural Districts Held to Be Worse Than in Cities

"We look around and say, 'What is the matter with America?' We should change this and say, 'What is the matter with Americans?' Has any of our commerce been destroyed? Have our cities been invaded? It behooves everyone of us to put our shoulder to the wheel and work, and if we do, we will get out of our trouble."

Thus did H. B. Melick of West Liberty, Iowa, re-elected president of the Iowa Telephone Association, address the 37th annual convention held at the Hotel Fort Des Moines, Des Moines, Iowa, February 24, 25, and 26.

President Melick said men think they are now passing through one of the greatest crises the world has ever known, but if they would think back to the days of George Washington they would realize their row is not as hard as it was then.

He said a great deal of the fault of the present situation in the telephone industry could be laid at the doors of those engaged in it. Until recently they did not sell, nor did they advertise, he said, and advised that the present trend toward sales campaigns and advertising campaigns be continued and increased.

"We must start at the bottom and educate our people," he said. "Advertise your service. Mail pamphlets to the homes of subscribers and non-subscribers. Some member of the family will read them and soon someone will comment on them."

Other officers elected in addition to President Melick were: J. M. Plaister, Fort Dodge, and L. D. Meyers, Woodbine, vice presidents, and Charles C. Deering, Des Moines, secretary-treasurer.

Directors re-elected were: H. B. Melick, J. M. Plaister, C. W. Quillen, Mount Pleasant; W. L. Agee, Marengo, and E. B. Samp, Sac City.

Five Per Cent Station Loss

In his report Secretary Deering said that although it was too early to give definite figures of station losses for the states, it would probably be about 5 per cent. He made the comment that although this is not a large loss compared with other businesses, it is surprising to telephone men, for it is their first experience with a loss in the history of this business.

J. K. Johnston of Indianapolis, Ind., secretary-treasurer of the Independent Pioneer Telephone Association of the United States, addressed the convention, speaking of the European tour sponsored by the Pioneer organization which sails from New York on May 27. He urged telephone men contemplating a trip to Europe to get in touch with Frank L. McKinney, 33 N. High street, Columbus, Ohio, president of the Pioneer association, and arrange to enjoy the trip with friends in the telephone business.

Speaking at the second convention session Ray Ingham, Cedar Rapids, general superintendent of the Iowa Electric company, addressed those assembled on "Co-operation Between Telephone and Electric Companies." He drew comparisons between telephone and electric light phraseology, to illustrate the differences in the two classes of utilities. He declared that a closer co-operation between these two utilities would help in improving relations with the public.

In discussing the relations between the two utilities he said the electric transmission company contends the telephone company has no priority on the highways and that the electric company should not be called upon to pay all the cost of modernizing telephone lines.

The speaker said the decisions of the railroad commission are generally fair and that the electric companies should pay the cost of moving telephone lines to the other side of the road. If the line is old, then a portion of the cost should be borne by the telephone company.

Urges Increased Advertising

"Publicity and Advertising," already a popular subject for discussion at the 1932 state telephone conventions, was discussed at Des Moines by J. C. Crowley, Jr., St. Paul, Minn., secretary-treasurer, Minnesota Telephone Association.

In opening his address Mr. Crowley cited the benefits advertising had achieved in other businesses. He then briefly outlined the development of the telephone industry from the year 1876, stating that up to 1893 there was no need for publicity or advertising. Advertising of long distance service first appeared in the fall of 1892 following the opening of service between New York and Chicago.

Up to the present day the long distance business has been widely advertised, Mr. Crowley said, adding that no one can say this advertising has not paid.

During the competitive era from 1894 to 1912 advertising was not indulged in to any extent by the Independent group because they had all the business they could manage, and in many instances unfilled orders because of a lack of switchboard or cable facilities. It was during the war period, Mr. Crowley said, when the adversities of the present time began with the smaller companies which had not kept in touch with the increased cost of labor and commodities.

He urged telephone companies to continue as much rehabilitation and reconstruction work as possible while labor and material prices are low. He suggested that the services of unemployed rural subscribers might be secured whenever possible in such work, thereby reducing their outstanding accounts.

He then advocated advertising to bring the value of the telephone continuously to the attention of the public.

He stated his belief that Independent companies are experiencing greater station losses than the Bell companies due to the fact that they largely serve rural communities. He advocated co-operation between the companies for more concentrated publicity and advertising in order to regain losses.

Discuss Taxation

Ed R. Brown, of Des Moines, secretary of the legislative committee on reduction of government expenses, delivered a lecture on the subject of taxation and told of efforts being made to reduce them.

F. B. McKinnon of Chicago, president of the United States Independent Telephone Association, was a guest of the Iowa convention, and told the delegates about hearings in Washington regarding taxation and of the appearance of representatives of various industries before the ways and means committee. He illustrated how taxes and tariff are related and then referred to statements made by himself and Vice-president H. A. Barnhart of the national association, as to why a tax should not be imposed on toll messages.

"Some Recent Court Decisions of Interest to the Industry," was the subject of an address by J. L. Parrish, Des Moines, counsel, Northwestern Bell Telephone company.

Mr. Parrish discussed the recent decision of the Iowa Supreme court in the so-called Allerton case, in which the court upheld the action of the Northwestern Bell company in refusing to ex-

(*Continued on page 46.*)

"All-Relay" Automatic Exchange Equipment

Explaining in Detail the Construction and Operation of the "All-Relay" Automatic Exchange, Manufactured by North Electric Manufacturing Company, Galion, Ohio; Desirable for Small Exchanges Because Need of Maintenance and Inspection Almost Eliminated

The enforced lull in business has at least given to the persons in control of the country's enterprises an opportunity to stand off and take a good look at them, at their past, their present and their probable future conditions; while the shifting and melting away of established values has enforced attention to costs and to relations between wages and expenses of mechanical equipment. In our own industry this enforced consideration has centered upon the application of automatic exchange equipment to all varieties of telephone service.

Our industry seems to have gone well beyond the stage of asking whether automatic exchanges will work and whether they will pay. Now as the wages of operators tend to diminish amongst the costs of operating telephone systems, being replaced in part by capital charges on mechanical equipment, it is becoming essential that owners and managers form sound opinions as to the relative merits and costs of different types of mechanical equipment.

Faults of Automatic Exchanges

All types of automatic exchanges in the field have won their places by showing themselves able to take the places of operators and save wages; but it is not a foregone conclusion that they are all alike—all equally complex, or troublesome, or durable. The differences in these particulars are, of course, less important in large exchanges where supervision by highly paid and highly skilled mechanics is available than in small exchanges where such skill and expense are out of the question.

The faults, failures, and repair bills of automatic exchanges are inherently of different kinds, and due to different causes from those in manual switchboards. The manual switchboard is the tool of the operator, and all sorts of operators use switchboards as all sorts of people use tools.

The automatic mechanical switching equipment operates under its own power. The forces which play through the parts can be foreseen, ensured, and provided for, the regularity with which the parts function, and the manner and rate of their deterioration in use can be planned for. Nevertheless, there are inherent and fundamental differences between different types of mechanical equipment which cannot be overcome by the utmost refinement in design or materials.

The "All-Relay" exchange has been designed to get clear away from the mechanical complexities, the nice adjustments, the wear of parts working together, the careful regulation of battery power, temperature, dust, lubrication, the frequent inspections and tests which have characterized all forms of step-by-step and power-driven automatic switching apparatus, and to make available, particularly for small and unattended exchanges, an equipment which is inherently capable of unsupervised, uninterrupted, unchanging operation under all conditions encountered in an isolated housing locked and left alone for long periods.

"All-Relay" Equipment

The "All-Relay" central switching equipment consists of these parts: (a) relays, (b) cables, (c) condensers, (d) resistance and impedance coils, (e) steel frame and cabinet. That's all.

It goes without saying that the cables, condensers, coils, and frames, properly made, do not fail in their functions and are of unlimited durability. They have been component parts of all manual and automatic exchange equipments, and have caused little or no trouble throughout the whole lives of exchanges if left free from manual disturbance. These parts in all well built exchanges are as good now as on the day they were made.

So attention may be concentrated on the relays.

In all common-battery manual and automatic exchanges there are a lot of relays. Those which are well made according to the accumulated knowledge of decades of manufacture make very little trouble. The ordinary relays in common-battery exchanges operate millions of times without failure.

The part which makes an automatic or mechanical switching equipment different from a manual exchange is the part which performs the selections. This is the mechanical contrivance which picks out the calling line, or the wanted line or a link or trunk, from amongst a lot of them, makes a connection with it during conversation, lets go of it and returns it to normal after conversation. It corresponds to the jack, which is the terminal of one part of the line, and the plug, which is the terminal of the other part of the line, and the hand which moves the plug, and the eye and the brain that direct the hand, in a manual board. The hand and the eye and the brain are the things the manager pays wages for in a manual system.

Selecting Gear

In an automatic system a bank of line terminals is always present, with the wires from the calling and the called lines soldered into the bank terminals; and there always is a motor magnet (sometimes several) taking the place of the hand, and some kind of gear taking the place of the eye, to direct the hand to the proper terminal. At this point we come upon a fundamental mechanical difference between the selecting gear of the "All-Relay" system and the selecting gear from all other types of automatic exchanges—not questions of better or worse materials, or of more or less adjustments, or of few or many parts, or of simplicity and complexity, but of a different way of doing the job, characterized by its own inherent merits and free in its own way from the faults in automatic systems long familiar and costly.

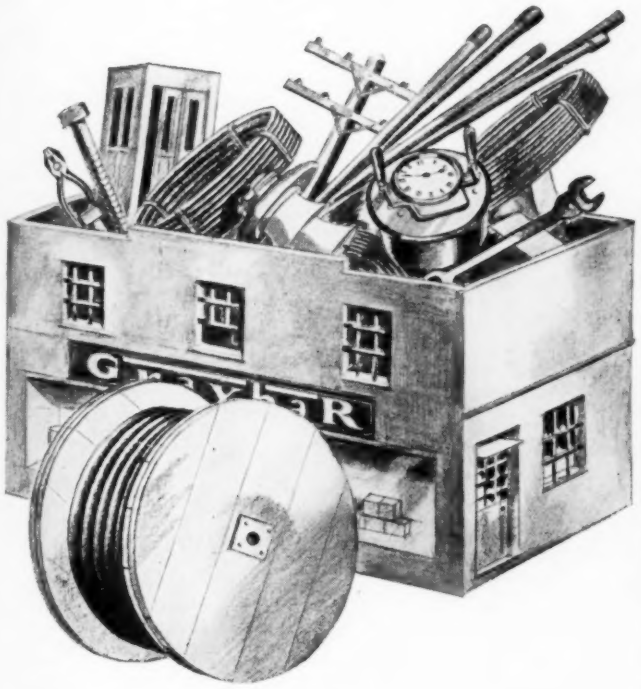
The "All-Relay" selector is composed of relays. The motor magnet is a relay magnet; the contacts are relay contacts; the eye that directs the selection is a relay; the brain that knows what number is wanted is a relay.

In the North "All-Relay" system the selector for a block of one hundred lines is composed of ten 33-point relays (known as "tens relays") and ten five-point relays (known as "units relays"). The "tens relay" has a rather powerful magnet, a rather wide and stocky armature, knife edge pivots; the armature lever carries 33 phosphor-bronze switch blades, which stand before 33 pairs of phosphor-bronze switch springs—30 being for tip, ring, and sleeve conductors for ten lines, and three to spare for a special purpose. When the magnet gets current the armature pulls up and pushes the 33 bronze switch blades between the leaves of the 33 pairs of springs and when the current is cut off the armature drops and the switch blades come out. And that's all there is to that. The "units relays" are constructed in the same way with fewer blades.

Construction of Magnets

The magnets are carefully constructed so as to be free from breaks and corrosion in the wires; they have plenty of power; they do not heat unduly when closed on their own batteries; they cannot be broken down by lightning or power-crosses outside. One of them will operate five or ten million times without failure. It takes one or two tenths of a second to

for every telephone need



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But that's not all. Out of its roster of 60,000 electrical items, Graybar is prepared to meet *any* need of a telephone industry. And behind *every* Graybar item stands the Graybar reputation for quality that goes back 62 years.

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operate. Double contacts for every circuit practically insure closure.

Of course, there is more to the "ALL-RELAY" hundred-line selector than that—but the rest is cable, soldered in place and never changed. There is a unique circuit arrangement uniting these 20 relays. There are ten "tens relays" and ten "units relays" for a hundred lines. Ten lines, say, 0 to 9, are multiplied on the switch-springs of the first "tens relay," the next block of ten lines on the second "tens relays," and so on. The conductors of the common link or "cord circuit" are multiplied on the ten "units relays"; the other contacts of each of the "units relays" are multiplied on the correspondingly numbered blades of all of the "tens relays," the number one "units relay" to the blades of the "tens relays" which make contact with the number one lines, the number two "units relay" to the blades of the "tens relays" which make contact with the number two lines, and so on. This makes a rather intricate but perfectly orderly piece of short cable soldered into the two sets of relays. For a block of one hundred lines there would be required a number of selectors, dependent on the number and duration of the calls in the hundred-line group. There are therefore as many links or cord-circuits as are needed, each ending on its own group of "units relays"; and each group of ten lines is multiplied onto the corresponding "tens relays" of the different selectors —that is the 0 to 9 lines on the 0 to 9 "tens relays" in all the selectors and so on.

Selection Relays

To connect with any particular one of a hundred times, throw current into the magnet of the right "tens relay" and into the magnet of the right "units relay," and you have it in about two-tenths of a second. All that happens is that the two magnets pull up their armatures and close the relay contacts; at release, the armatures drop away and the relay contacts open.

There is one set of "tens" and "units relays" for finding and connecting with calling lines, and another set for finding and connecting with called lines. When the number of lines is less than one hundred the "tens relays" not needed are left out, thus reducing the cost. If the exchange grows the needed "tens relays" are soldered into the cable, and the capacity is thus increased. When the exchange is larger than one hundred lines—and there are many such—an intermediate relay selector of the same kind is connected into the system, expanding it to one thousand or ten thousand.

When the selection relays are used as the line finder they operate under the control of the line relays; the line relay of the telephone taken for use closes a circuit through the magnet of the "tens relay" and through the magnet of the "units relay" having the numbers of the line calling, and a connection is made with an idle link instantly. When the calling subscriber operates his dial, the dial impulses are received one by one on the "register relays," of which the last one to be operated, corresponding to the number dialed, closes in the same way a circuit through the magnet of the "tens relay" and a circuit through the magnet of the "units relay" having the numbers of the wanted line, and the two relays complete the circuit from the calling to the wanted line. Of course, they close the usual busy test circuits at the same time. The busy test, busy tone, ringing, party line selection, closing the circuits for conversation, battery feed, release, are all performed by simple relays. Upon release the magnates simply let go.

Long Life of Equipment

All the moving parts—namely, the relays—of the "ALL-RELAY" exchange can be and are made of such sizes, weights, and materials as are conducive to many operations and long life without perceptible change. In this type of selecting structure there is no need for cutting down dimensions or weight of parts to obtain lightness at sacrifice of durability. There is no need for cutting down inertia to achieve speed of operation—the quickness of the simple direct response of the relay is normally so great as to leave ample margin for the speed of operation required in putting through telephone connections without making any sacrifice in design.

The ample range of movement of the armature, and the avoidance of communicating motion through a series of parts, make unnecessary the establishment and maintenance of minute adjustments, either in the manufacture or in the use of the apparatus.

Advantages of "All-Relay"

The telephone men who have watched through many years the slow development, the tedious overcoming of mechanical and electrical difficulties, the painstaking presentation of trials, descriptions, and economic results, the push to put the various forms of selecting machines to the practical work of performing telephone service accurately, cheaply, and economically, may well be wary and critical in accepting claims or expectations of being freed from all those difficulties at one fell swoop; but such claims and expectations would be worth thinking about. An understanding of the nature of the "ALL-RELAY" switching equipment prepares the mind to accept without too much reservation, the following propositions—and further examination will complete conviction.

The "ALL-RELAY" equipment never requires any lubrication.

It will never wear out within the life of telephone systems as they are now operated. None has ever worn out, even after 15 years of constant service.

The equipment does not require maintenance by a skilled man; there is no repair shop, nor tool kit, nor collection of spare parts.

There is no routine testing in any of the hundreds of "ALL-RELAY" exchange in operation.

The equipment is not affected by the extremes of heat or cold of any climate, and can be housed in a small building without temperature control.

The equipment can be located in isolated places, out of easy reach of inspectors and maintenance men, as the conditions of service may require.

The margins for safe operation are so great that they can be used on grounded line systems and on long many-party lines.

The complete elimination of operators and the almost complete elimination of maintenance and inspection, make savings which will pay for the equipment in two or three years.

"UNITED" SENDS GOOD-WILL MESSAGE TO SUBSCRIBERS

The United Telephone and Electric company of Abilene, Kans., has recently mailed an elaborate folder to all United telephone subscribers in the eleven states in which United companies are located. The United Telephone and Electric company is the mother company of these other properties.

The folder is colorful and lavishly illustrated. It is chiefly informative although written in an interesting and lively manner. On the envelope is printed in large type, "You Have a Right to Know," and on the front of the folder this sentence is completed as follows: "The Company Behind Your Telephone."

On opening the folder the heading reads, "You Have a Right to Know These Facts," and the ensuing material discloses interesting facts relating to the United companies, their founder and president, C. L. Brown, and a few of the many services in addition to simply the telephone service, provided by United companies.

Obviously the folder is purely a good will measure. According to Elliott Belden, head of publicity for the United companies, that organization believes in putting its best foot forward with customers as well as prospects. Mr. Belden, who designed and prepared the copy for this folder, says the company wishes to make every subscriber in every small town served by a United company, feel that he is in truth a part of a large and powerful organization.

. . . "YOU KNOW, JIM, OUR TELEPHONE SERVICE IS JUST ABOUT 100% PERFECT!" . . .

IT does a telephone manager's heart good to hear such comments as that. Far different from the old days, when a steady volume of complaints was the expected daily routine and everybody was "down" on the telephone company! Pretty hard under such conditions to secure needed rate revisions, obtain the backing of local civic bodies for expanded activities—or even to go out and sell extensions and new business.

How changed is the picture with Strowger Automatic operation! Everyone enthusiastic over the bettered service—business men using their telephones more—civic associations boasting of their city's excellent telephone system. Then, too, with many petty details of personnel supervision eliminated, the manager can devote more of his time to creating new business and bettering his business contacts.

From the angle of goodwill alone, Strowger Automatic equipment is a highly profitable investment. Just now, public opinion is assuming greater importance than ever before—and the bettered service brought by automatic operation is the one sure and proven means of obtaining it. Write TODAY—and let our engineers tell you how Strowger Automatic operation can help you, not only in securing public goodwill but in effecting permanent operating economies as well.

STROWGER AUTOMATIC DIAL SYSTEMS

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Manufacturers of Strowger Automatic Dial Telephone and Signaling Systems
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AUTOMATIC ELECTRIC SALES COMPANY LIMITED, 1027 W Van Buren St, Chicago, U. S. A.

NEBRASKA HOLDS 33RD CONVENTION

(*Continued from page* 19.)

general manager of the United Telephone company, Abilene, Kans. Mr. Coulson discussed the place of the publicity man in the service-selling picture, saying that said publicity man is in a position to display and execute more originality than those who have had charge of the destinies of telephone companies in the past.

He said that whereas telephone executives have reached a point of standardization of practices and methods, that restrains and holds back originality, publicity men are trained to search for new ways of expressing and doing the same old things.

"Telephone men ought not to be satisfied with being good mechanics doing a good job," Mr. Coulson said. "They must keep telling the people of the good job they have done and are doing, and in time the community will believe it."

Election of Officers

At the directors' meeting following the close of the convention, the old officers were re-elected. They are: George E. Becker, Pawnee City, president; D. E. McGregor, Gibbon, vice-president, W. E. Bell, Lincoln, treasurer; and George M. Kloidy, secretary.

This year's directors include: C. E. Hunt, Blair; George Daughetee, Oakdale; E. N. Davis, Cozad; H. C. Bratt, Columbus; W. R. Johnson, Omaha; G. E. Becker, Pawnee City; W. E. Bell, D. E. McGregor, and B. G. Miller, Crete.

VACUUM TUBE THEORY AND PRACTICE

(*Continued from page* 30.)

the tension on the diaphragm is increased so as to raise the reasonant frequency of the diaphragm above 5,000 cycles. The back plate on the more expensive condenser microphones is so arranged that equalization of pressure on the two sides of the diaphragm can take place, this being necessary or changes in barometric pressure would affect the sensitivity of this type microphone. Figure 5 illustrates the theory of the condenser microphone. Figure 6 shows a popular type of condenser microphone.

The condenser microphone operates by virtue of the change in capacitance between the rigid back plate and the flexible diaphragm when sound waves are impinged on the diaphragm. A high D.C. polarizing voltage is connected between the two plates and changes in capacitance cause a change in the charging current flowing to these plates. The circuit with which the condenser microphone is used is so arranged that these changes in charging current set up a voltage across the grid of the first amplifying tube which varies in synchronism with sound wave input.

A properly designed condenser microphone has a very faithful frequency response to well above 7,000 cycles, and is somewhat better than the carbon type where unusually high quality programs are to be picked up. However, for most purposes, especially public address, the carbon microphone is preferred because of its greater sensitivity and convenience from an installation standpoint.

The condenser microphone being a very high impedance instrument must be placed within a few feet of its amplifier otherwise distortion may result, or considerable noise picked up from nearby power wiring.

The output of the condenser type microphone will run from 20 to 30 db lower than that of the typical carbon button microphones.

One or two additional stages of amplification are therefore required to give the same output as the carbon type.

[NOTE.—Further information on Public Address Systems will be contained in a future issue.]

TELEPHONE ACQUISITION DENIED

The Northwestern Bell Telephone company, operating in St. Paul, has been denied permission to acquire control of the Tri-State Telephone and Telegraph company, operating in Minneapolis, by purchase of the capital stock, in a decision by the Interstate Commerce commission January 9, 1931. The decision held that the price proposed to be paid was excessive and exceeded the value of the equity represented by the stock by nearly $9,000,000.

Thus it appears that the plan for consolidation of the telephone lines and service of the Twin Cities, which has been under consideration for more than a year, will be at least temporarily abandoned.

The only recourse to the Northwestern company is an appeal to the United States courts from the ruling of the commission. Whether such an appeal will be made is something that the management and the legal department of the company must decide, according to Frank Bracelin, general manager of the company.

HARRIMAN AND LETCHWORTH MADE DIRECTORS

Lewis G. Harriman and Edward H. Letchworth, both of Buffalo, N. Y., were appointed directors of the New York Telephone company at the meeting of the board held February 24.

Mr. Harriman is president of the M & T Trust company of Buffalo, N. Y.; a director of the Federal Reserve Bank, Buffalo Branch; president of the Buffalo Clearing House association and has recently been appointed a member of the advisory committee for the Reconstruction Finance corporation.

Mr. Letchworth is an attorney and a member of the law firm of Kenefick, Cooke, Mitchell, Bass and Letchworth, of Buffalo.

With the exception of two years when he served as Deputy Attorney General of the state in Albany, and the years 1919 to 1922 when he was vice president and general counsel of the Marine Trust company of Buffalo, he has continued his connection with the above law firm.

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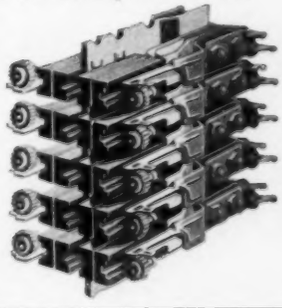

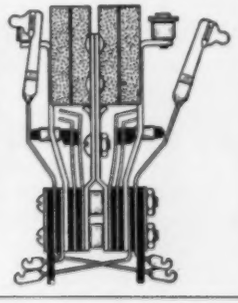

RAMBLINGS

In a fifteen hundred mile trip over Illinois, Indiana and Ohio, Rambler endeavored to learn of conditions prevailing in different cities and communities. Our impressions lead us to believe that an optimistic feeling permeates almost every section of the states visited.

* * *

Visiting Ottawa, Illinois, we found the Stewart Brothers busy as usual making test sets for the trade. They reported that business came from middle western and eastern states in greater volume than from southern and western states. They felt happy because they thought they could see daylight coming.

* * *

Over at St. Louis we found P. Kerr Higgins busy visiting his properties over Missouri. During the past year Mr. Higgins has had switchboard installations and reconstruction going on almost continuously in several exchanges. He is preparing for bettering the service, knowing that better times are in the offing.

* * *

Dropping down to Lawrenceville we found B. D. Quackenbush, general sales manager of the Suttle Equipment company, preparing one of the most elaborate catalogues ever undertaken by that firm. Asked what the outlook was, he replied that while sales were more numerous than for several months, the volume was still small as only necessary equipment was being ordered. He felt, however, this indicated a general loosening up of conditions in the territory covered by them.

* * *

At Terre Haute we found Hart Farwell happy because the previous month had been the best he had experienced in two years, he said. However, he added that his company had considerable distance to travel to reach the level of two years ago. A rate case at that time caused a heavy loss, which was followed by the readjustment period in which a number of subscribers felt the need of economizing, so his company suffered a further loss. Therefore he felt like rejoicing when conditions indicated a reversal.

* * *

In Indianapolis we found Secretary W. B. Beck of the Indiana Telephone association preparing to move his offices, but he stopped long enough to tell us that he was looking forward to a goodly gathering at the coming state convention. He reported unusual interest among the members and business generally fair.

* * *

At Dayton, Ohio, we found the L. M. Berry organization occupying very elaborate offices in the new Bell telephone building. They were rejoicing that recently they had been awarded the contract for the directory of the Dayton exchange of the Ohio Bell. We'll say its enough to cause rejoicing to have a plum of this importance dropped in their lap, even although the organization deserved it. Here's our congratulations, L. M. May your efforts be rewarded and your usefulness extended.

* * *

Naturally we could not go close to Warren Safford without stopping for a visit, so we next visited the town of Troy, Ohio. Seems like rate cases in Ohio are as plentiful as fleas on a Texas rabbit hound, and it was no different in Troy. Mr. Safford reported that his business had not suffered a loss until February of 1932, and then it was only slight. He was hopeful that the demand for lower rates would not materially affect the very pleasant relations existing between his company and the little city of Troy.

* * *

In Urbana, Ohio, we found Manager Neff with an ailment similar to that of Mr. Safford, except that his protestors were in one of the exchanges in a farming settlement and of smaller proportions. He stated that a committee of farmers advised him they were not interested in whether or not he or his stockholders made money; that they were only interested in the fact that they could not pay the price prevailing at that time. And so it goes.

* * *

Reaching Columbus, we proceeded to the office of Secretary Frank L. McKinney of the Ohio Independent Telephone association. Frank propped his feet high on his desk and gave us the low-down on conditions in his state. With the exception of sections where rates are being contested, things were in good shape with the telephone fraternity, McKinney stated. Only a few towns were mentioned where business was reported as unsatisfactory.

* * *

Frank R. McBerty, president and sales manager of the North Electric company, was visited at his Cleveland office. He states that the North Electric company enjoyed a very good business last year and he believes that before the end of the present year we will witness a general renewal of business activities which will become better as the year ends. The North Electric company, whose factory is located at Galion, Ohio, is developing equipment which, it is claimed, will greatly reduce the cost of service and prolong the life of the properties. This will prove interesting to those who are endeavoring to better the service and increase profits.

* * *

In Elyria we stopped to visit the offices of the Telkor company; what we discovered there is something almost revolutionary, but you will have to await the announcement by that concern, as we were requested to not divulge any secrets at this time. In due time the managers of this firm will announce a new apparatus which will attract a great deal of interest. But you'll have to let the boys at Telkor tell you about it.

* * *

Frank H. Knapp, president of the Northern Ohio Telephone company, was next visited. Mr. Knapp is located at Bellevue, Ohio, and in addition to his duties as president of the telephone properties in that section of the country, is president of one of the banks of his home town. He was responsible for bringing about the consolidation of two banks in Bellevue and became the head of the merged banks. Mr. Knapp expressed the opinion that conditions were readjusting themselves in Ohio and that we are on the verge of a general brightening of every line of industry.

* * *

So we reached Chicago feeling that the trip had been worth while and with renewed hope that another winter will find the laboring people working and the telephone industry carrying on as in former years.

INJUNCTION DELAYS NEW TELEPHONE BOOK

Executives of the Toledo division of the Ohio Bell Telephone company recently were considering the situation created by Dr. Fred N. Hayward, who obtained from the common pleas court a temporary injunction against distribution of the new directory, the day before it was due for general distribution, because, he claimed, he was not listed in the book.

In his petition, Dr. Hayward said the omission of his telephone and the fact that his number was listed for another person would do him "irreparable damage" professionally.

Telephone men over the country will be interested in the decision in this case.

TELEPHONE SERVICE EXPANDED AT HARTFORD, WIS.

About $4,000 will be spent by the Wisconsin Telephone company during the present month on additional rural telephone lines and rearranging of telephones in the vicinity of Hartford. About 56 miles of wire will be strung. When the additions and changes are completed, the rural telephone service out of Hartford will be materially improved.

W. L. Runzel, President, brings to this organization 41 years' experience in the manufacture of this type of telephone equipment

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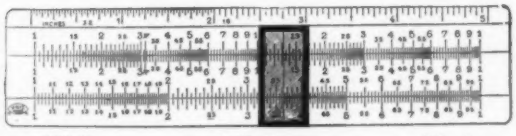

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H. S. DURLAND

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Toll operators are human!

It would be manifestly unfair to place blame on the toll operator who makes mistakes when no better time-keeping tools are provided than a visible indicator of the time of day, and a pencil. The telephone executive who argues that his operators today are personally "more efficient," "more expert," or "more experienced" than those of earlier generations, is only deceiving himself. Even the briefest experience with the Calculagraph proves this to him.

With utmost precision, the Calculagraph mechanically computes and prints ELAPSED TIME. A pull of the handle clearly and indelibly stamps *on the toll ticket* the time of day of each call, also the actual ELAPSED TIME the circuit is in use, for any number of calls. No arithmetic by pencil—no diversion from other duties—no chance of error—the Calculagraph is easily and quickly operated while conversing with either the calling or answering party. The Calculagraph is now supplied in either the well-known spring-driven model or an electric-driven model operated by electric impulses from a master clock (24 or 48 volts), or by self-starting synchronous motor (60 cycle A. C.). Prices and detailed information on request.

THE CALCULAGRAPH COMPANY

50 Church St. Dept. 22 New York City

CALCULAGRAPH

THE ELAPSED TIME RECORDER

News From the Field

The United Telephone company has men laying 3,000 feet of cable in its effort to give the subscribers of Canton, Kans., better service. The new cable will remove many telephone poles from alleys and reduce interference from trees and storms to a minimum.

A new common battery telephone central office recently was placed in service by the New Jersey Bell Telephone company, at Mt. Arlington, N. J., which will supply the entire lake front of Lake Hopatcong with modern service, thus doing away with the hand-cranks which formerly were used at each subscriber's telephone to signal operators. The central office is a new brick, residential type building, erected in Mt. Arlington.

The Wisconsin Telephone company has announced the opening of a business office for the accommodation of customers in the Bluemound-Greenfield area at West Allis, Wis. The new office will more conveniently provide for the business requirements of subscribers served by the Bluemound and Greenfield central offices.

The Southern New England Telephone company contemplates the following expenditures for 1932: $525,000 for buildings, $1,895,000 for central office equipment; $2,770,000 for equipment on subscribers' premises, and $2,555,000 for poles, wire, cable and underground conduit.

The Alexandria Telephone company, Alexandria, Minn., has announced that it will continue its program of placing wires and cables underground, started last year, throughout 1932.

Line reinforcement and repair work estimated to cost about $41,000 has been started on the Fargo-Bismarck, N. D., section of the long distance line.

The Indiana Associated Telephone corporation inaugurated its 1932 Add-A-Phone campaign with a banquet at Greencastle, Ind., held during the latter part of February. The Add-A-Phone campaign is a sales drive in which all employes of the company sell telephone service of every type. Due to the 1931 campaign, many communities of the company showed an increase in the number of telephones and subscribers. Even better results are anticipated in 1932.

Ninety officials and employes of the Iowa-Illinois Telephone company attended a district meeting at Aledo, Ill., recently.

The new Bell Telephone exchange building at Conshohocken, Pa., was opened recently. Entirely new and modern equipment was installed throughout the building, which consists of two stories, constructed of brick, concrete, and steel. It was started about two years ago.

The Lincoln Telephone and Telegraph company, Lincoln, Nebr., is offering to the boys and girls of high school age living in communities served by exchanges owned by the company, prizes for the best letters on, "What Our Telephone Means to Us." The purpose of the contest, according to officials, is to obtain a supply of first-hand facts about the value and use of the telephone made in the home.

Transfer of the Smithville Northern Telephone company, which serves subscribers in the towns of Smithville, N. Y., and German, N. Y., and are located in Chenango county, to the Chenango Valley Telephone company, has been approved by the public service commission. The Smithville company operates a system of about 60 stations.

Ending a long controversy, the Northwestern Bell Telephone company has finally been given the city telephone franchise in Atlantic, Ia. It was granted to the company by a popular vote of 486 to 318.

The Wisconsin Telephone company reports that it costs thousands of dollars each year to replace telephone poles damaged by squirrels and woodpeckers.

The Bell Telephone company is improving six miles of rural line along state highway No. 24 east of Carrollton, Mo. All old poles are being replaced and new wire is being used to repair that which has become inadequate after a number of years' service.

A construction crew has started work on installation of new telephone cable between Bismarck and Mandan, N. D. The estimated cost of the project is $52,000.

The Wisconsin Telephone company has announced an appropriation of $22,000 for additions, extensions, and improvements to the telephone system in Chippewa Falls, Wis., during 1932.

Equipment is soon to be installed in the new Hilltop dial exchange, Milwaukee, Wis., which has almost reached completion. Total cost of building and equipment will be $1,500,000.

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1. Seamless zinc cup, uniform in thickness throughout, free from joints and foreign metals, free from electro couples and dry cell cancer.

2. D-W Patented paper-thin insulator holds more electrolyte, takes up less space and admits more mix.

3. Air-tight sealed top prevents evaporation, preserves contents and insures delivery of full capacity to the line, irrespective of time or age—

—all resulting in lowest cost of battery maintenance. Trial at our expense if not proved.

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FANSTEEL ISSUES TECHNICAL RECTIFIER CATALOG

The Fansteel Products company, Inc., North Chicago, Ill., has just issued a new Fansteel rectifier catalog, number TC-37, which contains a quantity of useful information for the telephone engineer and plant man.

The Fansteel rectifier principle of operation is explained in this 16-page technical catalog, also the various types, their uses and characteristics.

Of particular interest to the telephone man is the noiseless telephone rectifier, described in the catalog, which has proved to be useful for PBX, toll, magneto, or common battery central office batteries. It is installed as a power saver for float charging during light load periods.

There is also the Fansteel type cab combination power units which consist of a Fansteel rectifier, transformer, rheostat, and a 4, 6, or 8 volt storage battery assembled in a compact steel cabinet. This combination is used for furnishing the low operating current to inter-communicating or magneto telephone transmitters, alarm, signal, time, instrument and other systems requiring unfailing low voltage D. C. power.

Fansteel telephone selector and telegraph power units for furnishing high voltage direct current from an A. C. supply to operate telephone selectors and telegraph circuits, are also fully described.

FWD PLANT HAS THREE FULL SHIFTS

"We finished the year 1931 and are entering the year 1932," states W. A. Olen, president and general manager of the Four Wheel Drive Auto company, Clintonville, Wis., "with the largest volume of commercial orders on our books in the history of the company, necessitating the operation of all the machine departments of the company twenty-four hours a day, represented by three eight-hour shifts and running full five and one-half days a week; by operating all the assembling departments and transportation departments eight hours a day with full crews full five and one-half days a week; with all administration forces operating full nine hours a day for full weeks and with a service department operating all hours of all days throughout the entire week. Our survey of our markets indicates that we will be busier in 1932 than we were in 1931, for FWD trucks are constantly assuming greater responsibility in building roads; keeping them open both summer and winter, and in the transportation of the more important industries throughout the civilized world."

The FWD company has increased its selling and advertising program for this year and will continue its policy of concentrating on natural FWD markets. This policy has enabled the FWD company to work closely with prospects and users and render them intelligent service with their trucking problems. This year three new markets, in which FWD trucks can render a distinct service, have been added to the list.

New models have been developed, which will shortly be announced. One is a front drive truck and the other is a model which has been completely designed for appearance. "The FWD truck, to reverse an old saying," says E. K. Bard, FWD artist-engineer, "is now ornamental as well as useful."

PUBLIC SERVICE COMPANY BUYS SWITCHBOARD

The Southeast Public Service company of Charlottesville, Va., recently purchased a 6-800 Masterbuilt switchboard from the Kellogg Switchboard and Supply company for installation in its Alta Vista, Va., exchange. This is the second Masterbuilt switchboard recently purchased by the company. The first board was installed in the Elkin, North Carolina, exchange.

The Southeastern Public Service company under the direction of L. D. Densmore is rapidly improving its Virginia properties, with complete reconstruction and new equipment where necessary. This general policy of improvement and expression is meeting with hearty approval from the public and is largely responsible for the excellent public relations and the huge subscriber list in the face of nation-wide difficulties.

Each project is carefully laid out from an engineering, operation and investment standpoint and nothing but the highest grade of material and workmanship is tolerated.

The new equipment for Alta Vista will consist of a one position 6-800 Masterbuilt switchboard wired and equipped for 100 common battery local lines, ten toll lines and ten rural lines. The board is also equipped with twenty combined drops and jacks. The Masterbuilt switchboard assures Alta Vista subscribers of the finest type of service.

Because of its great flexibility this equipment will permit economical growth. Should changes in toll or rural positions be necessary, they can be made overnight without service interruptions. Mr. Densmore, plans to have the new board cut into service some time early in 1932

WILSON NOW REPRESENTS KEARNEY CORP.

The James R. Kearney corporation announces the appointment of Alfred C. Wilson, formerly with the Chance company, as special representative in the Southeastern territory.

Mr. Wilson was graduated from Georgia Tech in 1903 after which he spent several years with the Georgia Railway & Electric company. He afterwards was associated with Lockwood Green & company, consulting engineers, as assistant electrical engineer for the Southern division. He was subsequently connected with the Western Electric company, Johns Manville company and the H. C. Biglin company. His most recent connection was with the Chance company, which recently merged with the James R. Kearney corporation.

Mr. Wilson's friends will be glad to know of his association with the Kearney corporation.

POSITION WANTED

Full time position desired by experienced telephone man with training in all branches of toll work and versed in care of local switchboards of manual type, storage batteries, ringing machines, generators, etc. Three years with Bell companies. For further information write NA, care Telephone Engineer.

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FOR USE
IN COLD WINDY WEATHER

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Powerful flame—2000° F.
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Easily cleaned and serviced.

Try one for 30 days

UNIQUE MFG. CO., INC.
221 Whiting St. Chicago, Ill.

ADVERTISING IS THEME OF IOWA CONVENTION

(*Continued from page* 35.)

tend toll connections to a recently organized company on the grounds that it already was furnishing such service to a company which has been operating in Allerton for a period of years.

Other convention speakers were George X. Cannon, Freeport, Ill., a director of the United States Independent Telephone association and a past president of the Illinois Telephone association, who spoke on "Some Fundamentals of the Telephone Business"; Frank Milhollan, Omaha, Nebr., president, Central West Public Service company, whose address was called "The Value of Telephone Service to the Farmer"; and the always popular convention speaker, A. L. Staderman, Terre Haute, Ind., chief engineer, Citizens Independent Telephone company, whose subject was: "Pole Line Engineering."

PORTER REMAINS CHAIRMAN OF FOUNDATION

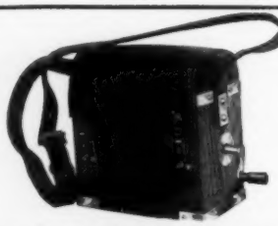
H. Hobart Porter of New York has been re-elected chairman of the Engineering Foundation, research organization of the national societies of civil, mining and metallurgical, mechanical and electrical engineers.

Mr. Porter is president of the American Water Works and Electric company, and chairman of the board of the West Penn Electric company.

SCIENTIST RECEIVES AWARD FOR ACHIEVEMENT

Irving Langmuir, research chemist and physicist, and associate director of the Research Laboratories of the General Electric company, at Schenectady, N. Y., is this year's winner of the Popular Science Monthly Annual Award of $10,000 for notable scientific achievement. Dr. Langmuir was singled out for the distinction from hundreds of candidates in recognition of his numerous contributions to pure and applied science, among which his inventions of the nitrogen-filled incandescent electric light bulb and the atomic welding arc are conspicuous. The award, together with a gold medal commemorating it, was presented to Dr. Langmuir on February 29 in New York City.

The Southern California Telephone company plans to spend $9,680,000 on development of the system in Los Angeles, Calif., during 1932.



THE NEW STEWART TEST SET WITH DETECTOR COIL

Tells where your trouble is without opening the line. Two sizes: 7 & 12 lbs. Price $36.00. Trade in your old set.

STEWART BROTHERS, Ottawa, Ill.

RECONSTRUCTED EQUIPMENT

Western Elec. No. 25A or No. 76 repeating coils—2 coils mounted on one mounting block, per pair @	$ 5.25
Kellogg No. 101E 500 ohm combine line drops and jacks, 10 per strip @	11.50
Stromberg No. 11 combine line drops and jacks, per strip of 5 @	7.00
Holtzer-Cabot 110-volt A. C. Motor H. P. ⅛ Speed 1150 R. P. M. @	10.00
Kellogg No. 2812 Latest type 5-bar 1600 ohm Bdg. compacts @	10.50
Kellogg No. 84 desk set with No. 2361 5-bar 1600 ohm inside connection signal set @	11.75
Kellogg No. 301 Combine line drops and jacks, per strip of 5 @	7.50
Kellogg No. 97 C. B. desk set with Straight line No. 75 Steel bell box @	7.00
Cook No. 10 Arresters, per bank of 20 lines with heat coils @	8.50
Chicago Tel. Supply Co. 4-bar 1600 ohm Bdg. compacts @	6.25
Western Elec. No. 22 3-bar Generators with Crank & Screws @	1.50
Stromberg No. 104 type 4-bar 1600 ohm Bdg. compacts @	6.90
Automatic Elec. Receivers with cord and New W. E. Shell and Cap @	1.10
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Our Stock Is Immense—Magneto or Common Battery—including Switchboards—Switchboard Apparatus—Telephones—Protection Equipment—Cable—everything you need for the installation of a new exchange or maintaining your present one.

Twenty Years Successful Operation of this Department in connection with our business puts it past the experimental state—Quality and Price have made our customers permanent—it will pay YOU to investigate.

Ask for Free Bulletin. Address

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5-bar, 1600 @ $11.00
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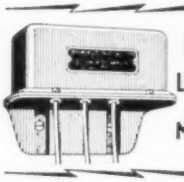

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